# ORR'S

# CIRCLE OF THE SCIENCES:

A SERIES OF TREATISES ON THE PRINCIPLES OF SCIENCE, WITH THEIR APPLICATION TO PRACTICAL PURSUITS.

VOLUME III.

ORGANIC NATURE—VOL. III.

VERTEBRATED ANIMALS—W. S. DALLAS, F.L.S.

NEW EDITION.

LONDON AND GLASGOW:
RICHARD GRIFFIN AND COMPANY
PUBLISHERS TO THE UNIVERSITY OF GLASGOW.

1860.

# CONTENTS.

## DIVISION V.—VERTEBRATA.



## CLASS I.—FISHES.



## CLASS II.—BATRACHIA.



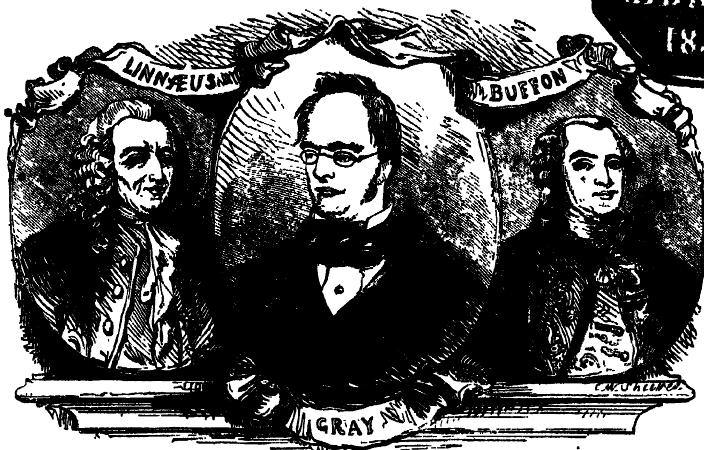
## CLASS III.—REPTILIA.

## CLASS IV.—AVES.



## CLASS V.—MAMMALIA.

# LIST OF ILLUSTRATIVE ENGRAVINGS.




# NATURAL HISTORY OF ANIMALS

## DIVISION V.—VERTEBRATA.

**General Characters.**—In the preceding volume we have traced the general characters and classification of the four great groups of Invertebrate Animals; there remains only the fifth and highest division of the Animal Kingdom, the VERTEBRATA, including perhaps fewer species than some of the preceding divisions, but calling for a greater share of our attention, both from its numbering amongst its members our own species and those which most closely approach us in organization and intelligence, and from the circumstance that nearly all our domestic animals, and the majority of those which are in any way useful to the human race, belong to its ranks.

The most essential character of this great and important division of the Animal Kingdom, consists in their possession of a bony or cartilaginous internal skeleton, serving partly for the protection and support of the internal organs, and partly for the attachment of the muscles by which motion is effected. The admirable paper by Professor Owen "On the Principal Forms of the Skeleton," in a preceding volume, will preclude the necessity of our dwelling upon the structure of this set of organs at any great length; but the proper comprehension of this portion of our subject requires that we should furnish the reader with a short account of the general principles upon which the bony framework of Vertebrate animals is constructed.

Of this, the most essential and persistent portion is that called the *spine* or *vertebral column*. It forms the centre of the whole skeleton, and serves to connect all the other parts of the structure, which are, in fact, merely to be regarded as its appendages. It is never wanting in any animal of this division, although in some of the lowest species

(the only fishes, in fact, whose title to a position amongst Vertebrated animals has ever been disputed) it forms merely a semi-cartilaginous cord (the *chorda dorsalis*), presenting a considerable resemblance to the earliest form of the vertebral column in the embryos of the higher Vertebrata.

In the majority of these animals, however, the spinal column consists of a number of segments (*vertebræ*) united together in such a manner as to allow of a greater or less degree of flexibility (Fig. 1), and giving rise to various appendages, of which some serve for the support and protection of the most important organs, whilst others assist in the motions of the animal.



Fig. 1.—Vertebral column.

Each vertebra (Fig. 2) is composed of a centre or body (*a*), a short more or less cylindrical bone, which is articulated to its fellows on either side in various modes —sometimes by a regular ball and socket joint, sometimes by the interposition of plates of fibro-cartilage between the flattened end-surfaces, or by the insertion of bags of fluid into cavities left in the same situation. From the upper surface of the body of each vertebra springs a bony arch (*b*), composed essentially of several bones, which are usually completely united together, and to the centre of the vertebra. The apertures thus formed in the vertebræ constitute a sort of bony tube, through which the central axis of the nervous system passes, and is thus protected from external injury. From this circumstance the arches formed by the superior appendages of the vertebral centre are denominated the *neural* arches (Gr. *neuron*, a nerve). The number of pieces of which the spine is composed, which, although variable, is always considerable, confers a great amount of flexibility upon the entire column; whilst from the shortness thus acquired by the individual joints, the flexure of the whole is effected without any of those sudden bendings which might injure the delicate and important organ that passes through their apertures. With the addition of a few bony processes, which serve either for the attachment of muscles for the movement of the spine, or to control its flexion, either by their actual contact or by furnishing points of attachment for ligaments, we have the vertebra of the human anatomist. But the vertebral segment of the philosophical anatomist includes much more than this: it is completed by a second arch, formed of several bones, which incloses a space beneath the body of the vertebra; and this, from its protecting the principal organs of the circulatory system, is denominated the *hæmal arch*. The degree of development of this inferior arch is very variable. It is often imperfect—that is to say, the bones of which its two sides are composed are frequently not united at their extremities; and in many cases this arch appears to be entirely wanting.




Fig. 2. Vertebra.

Of this second arch, the best examples are to be found in the *ribs*, the long curved bones which inclose the cavity of the chest in most vertebrated animals, usually articulated by a moveable joint to their corresponding vertebræ, and frequently united at their extremities to a central piece, the *sternum*, which completes the hæmal arch.

At its posterior extremity the vertebral column is usually produced into series of gradually diminishing vertebræ, of greater or less length as compared with the body. These constitute the tail, which in fishes and whales forms the principal organ of locomotion.

At its anterior extremity the vertebral column terminates in a bony case, the *skull* or *cranium*, of which the cavity incloses the brain, or centre of the nervous system;

the spinal cord, which, as we have already said, runs through the tube formed by the apertures of the spinal column, communicating with this central nervous mass by a corresponding opening in the base of the skull. Below and in front of this bony case are several bones, forming the face and jaws of the animal; and the whole may be considered as constituting the skeleton of the head. It is difficult at first sight to refer these irregular and complicated bones to the same type of structure as the vertebræ forming the spine; but the researches of several illustrious naturalists, amongst whom none perhaps have contributed more to the result than our countryman Professor Owen, have now placed it beyond a doubt that the cranium is composed of the neural arches of several vertebræ, and that the bones of the face are the hæmal arches of some of these. According to the views of Professor Owen, the skull is composed of four neural arches, of which one (*nasal*) includes the bones forming the nose; the second (*frontal*) is formed principally by the frontal bones; the third (*parietal*) includes the parietal bones, the alisphenoids and the mastoids; and the fourth and hindmost (*occipital*) the occipital bones, which form only a single bone in many Vertebrata. The centres of these vertebræ form the floor of the cerebral chamber; that of the occipital vertebra constitutes the lower boundary of the large aperture, through which the spinal cord communicates with the brain. The bones of the face, the upper and lower jaws, are the hæmal arches of the first two of these vertebræ; and the corresponding arch of the third vertebra, is the *hyoid bone*, which supports the tongue and assists in its movements. The hæmal arch of the fourth cranial vertebra is composed of certain bones of very variable form, which support the anterior limbs; and although these, in many Vertebrata, are removed to a considerable distance from the head, in the Fishes and some other members of the group they are actually articulated to the hinder part of the skull; and as, in all cases, they are evidently identical organs, analogy forbids us from giving them different derivations.

The fore-limbs of the Vertebrata are regarded as appendages of this hæmal arch, and the hind limbs as similar appendages of another bony arch (the *pelvis*), which is firmly attached to one or more vertebræ at the posterior extremity of the trunk. The majority of the Vertebrata possess two pairs of these organs; but the hinder pair is deficient in a considerable number of fishes, in the whales and some other animals, whilst the serpents and some fishes are totally deprived of limbs. In none, however, does the number of these organs exceed four. The structure of the limbs is essentially the same in all vertebrated animals; and it is entirely by the modification of this typical structure that those multifarious and beautiful contrivances which adapt these creatures to such various spheres of action are obtained. It is, indeed, in the modifications which these parts undergo, whilst still retaining their primitive character, that the natural theologian finds the most striking of those instances of design in creation upon which he loves to dwell; and it is upon these also that the zoologist depends, to a great extent, for the means of classifying and characterizing the numerous members of this important group.

The conformation of the bones of all the limbs is very similar. They commence by a bone, usually of an elongated, cylindrical form, which articulates by one extremity with the supporting bony arch; this is the bone of the arm or thigh (*humerus* or *femur*). At its free extremity, this bone furnishes a point of articulation for a pair of parallel bones, forming the fore-arm and the shank of the leg; in the anterior extremity these are denominated the *radius* and *ulna*; in the hinder limb they bear the names of *tibia* and *fibula*. They are frequently united at the two extremities, or even amalga-

mated, throughout their length, into a single flattened bone, which, however, generally exhibits distinct traces of its original composition. When separate they also usually possess a considerable amount of independent motion; the *ulna* and the *tibia* being firmly articulated to the extremity of the preceding bone; whilst the *radius* and *fibula*, which have less to do with the formation of this articulation, are capable of rotating to a greater or less extent round their more immoveable fellow. At the extremity of the bones of the fore-arm and shank, the first of those of the hand and foot are articulated (the *carpal* and *tarsal* bones). These consist of a variable number of short bones, forming the wrist and the base of the foot with the heel. Beyond these come the *metacarpal* and *metatarsal* bones; these, five in number in many Vertebrata, are arranged in a transverse series, articulating by their bases with the carpals and tarsals. Their number, however, is often greatly reduced, in many cases only one of them remaining. They are followed by the *phalanges*, or bones of the fingers and toes, of which each metacarpal or metatarsal bone appears normally to bear three; like the preceding bones, they are often reduced to a single series. We need not refer in this place to the manifold changes which these parts undergo to adapt them for the varied necessities of the animals composing this great division. These have been admirably described by Professor Owen in the paper already referred to; and we shall have occasion, in the sequel, to notice most of them in characterizing the different groups into which these animals are divided.

An essential distinction from the articulated series of animals is to be found in the mode in which the jaws of the *Vertebrata* open. In the Articulata, the jaws always separate laterally, so that the opening of the mouth is in the same direction as the axis of the body. In the Vertebrata, on the contrary, the jaws open vertically, and the oral aperture is consequently horizontal, or transverse to the general axis. The muscles of vertebrate animals are also placed on the *outside* of the bony skeleton; whilst, in the Articulata, the external skeleton forms a series of rings, to the *interior* of which the muscles are attached; even in those Vertebrata in which the skin is covered with bony or horny plates, forming a dermo-skeleton, which may be regarded, to a certain extent, as analogous with the external skeleton of the Articulata, all the more important muscles still find their points of attachment on the true skeleton, the general structure of which we have just been describing. In the majority of the Vertebrata, the outer integument is composed of a flexible skin, of which the surface is usually covered with scales, feathers, or hairs.

In the structure of the nervous system, the Vertebrata present a great advance upon all the animals of the Invertebrate groups. The centre of this system is far more concentrated in its form, and exhibits a far greater preponderance over the other parts. It forms what is called the *cerebro-spinal axis*, and is composed of the brain, a mass of nervous matter inclosed within the cavity of the skull, and of a cord of similar matter which runs down the canal formed by the neural arches of the vertebral column (Fig. 3). From the latter the nerves are given off, the ultimate branches of which are distributed to the various organs of the body.

The brain, the seat of intelligence and volition, varies greatly in its development in the different members of this division. In man (Fig. 3), and many of the higher Vertebrata, it attains a great preponderance over the remainder of the nervous system; and the anterior portion, especially the *cerebrum*, or true brain, which is universally regarded as the organ of the mind, acquires a great development. In the lower forms, such as the fishes, on the contrary, the brain is small; and, in many cases, its bulk is made up principally of those parts which are subservient to the organs of special sense.

These are always present in the Vertebrata; and, indeed, with but few exceptions, all these animals possess organs of sight, hearing, smell, and taste, in a state of considerable perfection. With one exception, auditory organs are possessed by all Vertebrata. In the lower forms, they are indeed of very simple construction, and completely inclosed within the head, with no communication with the external world, so that it is difficult to imagine that they can furnish their possessor with any distinct perception of sounds. By degrees, however, their structure becomes more perfect, and they, at the same time, approach the surface of the head, where they acquire an opening which facilitates their reception of external impressions, and which is often furnished with a funnel-like external ear, by which the sonorous vibrations are conducted to the internal organs. Eyes are wanting in a greater number of these creatures; but, as a general rule, the visual organs are present in great perfection. In the Fishes, the cavity of the nose is completely closed posteriorly; but in all other Vertebrata there is a free passage through this organ, either into the mouth or the pharynx. In some forms, in which the sense of smell appears to be very imperfect, the nasal cavity forms mere sacs, or simple tubes, for the passage of air to the lungs; whilst in those which possess this sense in a state of greater perfection, the surface of this cavity is increased by a complicated arrangement of bony cells, clothed with mucous membrane, and richly provided with nerves. The sense of taste is exercised by the tongue; but this organ is often of a hard and horny consistency, or modified in other ways so as to render its gustatory powers very doubtful; it is sometimes capable of considerable movement, but frequently immoveably attached to the floor of the mouth.

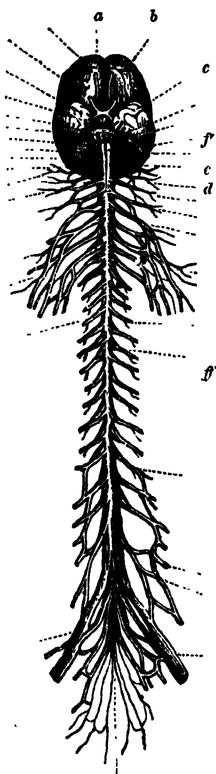



Fig. 3.—Cerebro-spinal axis of Man; *a*, cerebrum; *b*, anterior lobe; *c*, middle lobe; *d*, posterior lobe; *e*, cerebellum; *f'*, medulla oblongata; *ff*, spinal cord.

The alimentary organs are very similar throughout the group. The mouth is generally furnished with teeth, which are sometimes confined to the jaws, sometimes distributed over all the other bones which assist in the formation of the oral cavity. In the Birds, the Tortoises, and a few other Vertebrate animals, the teeth are entirely wanting. In the former, the jaws are covered with horny plates, which serve instead of teeth for the division of the food. In some of the lowest Fishes, even the jaws are absent. From the mouth a membranous tube, the *œsophagus*, leads to a dilated portion of the alimentary canal, the *stomach*, in which the process of digestion commences; from this the food passes into a tube of variable width, the *intestine*, in which the principal absorption of alimentary matters takes place (See PHYSIOLOGY). This leads to a posterior aperture, the *anus*, through which the refuse of the digestive process is discharged. The different parts of the intestinal canal have received different names from anatomists. The opening leading from the stomach into the intestine is denominated the *pylorus;* the part of the intestine immediately following this is called the *duodenum;* this is succeeded by the *small intestines*, which are coiled together in a

voluminous mass in the cavity of the belly, and terminate in the large intestine, which is continued, under the names of the *colon* and *rectum*, to the anal opening (Fig. 4). The large intestine frequently terminates in one or more blind extremities (*cæca*), which project beyond the point at which the small intestine enters it. Various glandular organs occur in the course of the alimentary canal. Of these, the *salivary glands* are situated in the neighbourhood of the mouth, into which they pour their secretion during the mastication of food; they are wanting in the Fishes and some other aquatic animals. The *liver*, the largest of all the glandular organs of the body, is placed close to the stomach, and pours its secretion, the bile, into that portion of the intestine denominated the duodenum, which also receives the saliva-like secretion of another glandular organ, the *pancreas*, situated in its immediate neighbourhood. The latter organ is wanting in some fishes. The *spleen*, a glandular organ peculiar to the Vertebrata, is also wanting in some fishes; it is contained, like the preceding, in the abdominal cavity; but its functions are not yet clearly ascertained.

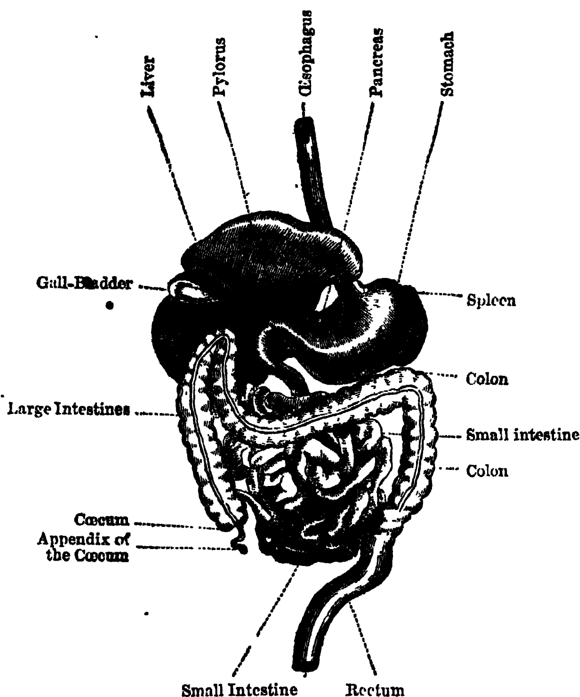



Fig. 4.—Digestive apparatus of Man.

The blood in the Vertebrata (with but a single exception) is always of a red colour. This is due to the presence in the blood of a multitude of minute red particles (*globules, corpuscles*) of a round or oval form, the fluid portion being colourless. In this particular, the animals of this division differ from all the Invertebrata, in which any perceptible coloration of the blood is inherent in that fluid itself, and not due to the suspension of coloured particles in an otherwise colourless fluid. The circulatory system also exhibits a completeness which we do not meet with in the Invertebrata; the heart, with the single exception of the *Amphioxus*, is always muscular, and the blood is carried to and from that organ in a complete system of vessels,—never, as in the majority of invertebrate animals, passing through mere cavities hollowed out in the other tissues of the body.

The structure and arrangement of the circulatory system present considerable variations, principally in accordance with the conformation of the respiratory organs. In the aquatic forms, respiration is effected by the agency of gills, which usually take the form of vascular bands, supported upon bony or cartilaginous processes of the hyoid bone, and bearing an apparatus of minute laminæ, or tufts of filaments, permeated by capillary vessels, through which the blood passes, and is thus exposed to the action of the surrounding medium. The water required for respiration is taken in by the mouth, and passes out through openings at the posterior part of that cavity, whence it passes over the branchial apparatus. In the Fishes, which present us with this form of respiratory apparatus, the heart consists only of two cavities, of which one receives the blood on its return from the organs of the body, whilst the other drives it through the gills, thence to be distributed to the various organs by the arteries. The air-breathing Vertebrata are all furnished with *lungs*, cellular or spongy organs inclosed in the cavity of the chest, into which the air passes by the mouth, or nasal passages, and is returned by the same route. The cellular texture of the interior of the lungs is permeated in every part by capillary blood vessels; and it is in these that the blood comes in contact with the air, and receives its revivifying influence. But the blood, in these animals, instead of passing from the lungs directly into the arteries, returns again to the heart, and is driven out from this into the arteries. In consequence of this arrangement, the heart acquires a more complicated structure than in Fishes; the recipient chamber (*auricle*) becomes doubled, and, in the higher forms, the expellent chamber (*ventricle*) is also divided into two cavities by a longitudinal partition, so as to form, as it were, two hearts, one subservient to the respiratory process, the other to the general circulation. In addition to the proper blood-vessels, we meet in the bodies of vertebrate animals with a system of absorbent vessels, connected with the sanguiferous system, some of which convey the products of digestion from the walls of the intestinal canal into the circulation; whilst others, which ramify through all the organs of the body, take up a clear fluid, called *lymph*, and carry it to the same destination. The former of these vessels are denominated *lacteals*, from the milky appearance of the fluid contained in them; the latter *lymphatics*, from the nature of their contents. Both sets of vessels terminate in a common trunk, the *thoracic duct*, which discharges its contents into one of the principal veins in the neighbourhood of the heart.

The nitrogenous waste substances are got rid of by the agency of the urinary organs, of which the *kidneys* are the most important; their secretion sometimes passes off by a particular opening; but is usually discharged into the hinder part of the intestinal canal, and evacuated through the anal aperture with the fœcal matters.

The reproduction of the Vertebrata is always sexual, and the sexes are invariably on separate individuals. No authentic instance of hermaphrodism has ever been recorded amongst these creatures; and all the supposed cases of the occurrence of this phenomenon have originated in the imperfect observation of peculiar malformations.

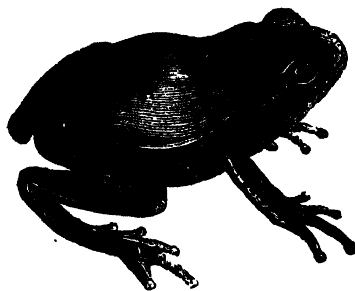
The majority of the Vertebrata are oviparous animals, producing perfect eggs, which contain all the materials necessary for the development of the embryo. A few retain the eggs in the oviducts until the young are ready to be hatched, and these are frequently denominated ovo-viviparous; whilst one class, the Mammalia, is composed of truly viviparous animals, in which the embryo early acquires a vascular connection with the mother, and thus, deriving its nourishment from her blood, continues its development to a far greater extent than could have been effected by means of the materials contained in the impregnated ovum.

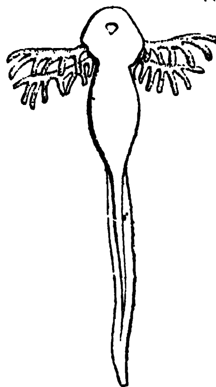
The development of the embryo always takes place from a given spot on the surface of the yelk, and never, as in many invertebrate animals, by the conversion of the entire yelk into an embryo. At first the embryo forms a slight elevation at the surface of the yelk sac; this gradually increases in size, and forms a sort of disç, embracing a larger or smaller portion of the yelk, with a slightly elevated line running along its dorsal surface. In this the rudiments of the spinal cord and vertebral column soon make their appearance, followed by the heart and circulatory system. The yelk sac is gradually absorbed into the body of the embryo, with the alimentary canal of which it stands in connection; but in many cases it forms a distinct sac dependent from the belly of the young animal, and persistent after this is excluded from the egg.

**Divisions.**—We divide the Vertebrata into five classes, of which the first four are composed of oviparous animals. Of these, the first includes the vast group of Fishes (Pisces), animals adapted exclusively for an aquatic life, respiring by means of gills, and furnished with a heart with only two cavities. Their extremities are converted into fins, and their motions are principally effected by lateral strokes of the expanded tail. They are cold-blooded animals, and their skins are either naked or covered with scales. The nose is usually imperforate posteriorly.


Fig. 5.—Cod-fish.

The second class, the Batrachia, is formed by some singular animals, which are furnished with gills for aquatic respiration, during the whole or part of their existence, although they always ultimately acquire lungs and the power of aërial respiration. The nasal cavities open into the mouth; the heart is formed of three chambers; the blood is cold; and the skin usually naked. When mature, these animals are usually furnished with four true feet.


Fig. 6.—Hyla, or Tree-Frog.


Fig. 7.—Tadpole, or Young Batrachian.

The other two classes of oviparous Vertebrata never possess gills at any period of their existence. In one, the class of Reptiles (Reptilia), the blood is cold, and the heart composed


Fig. 8.—Crocodile.

of only three cavities—one ventricle and two auricles; the limbs, when present,

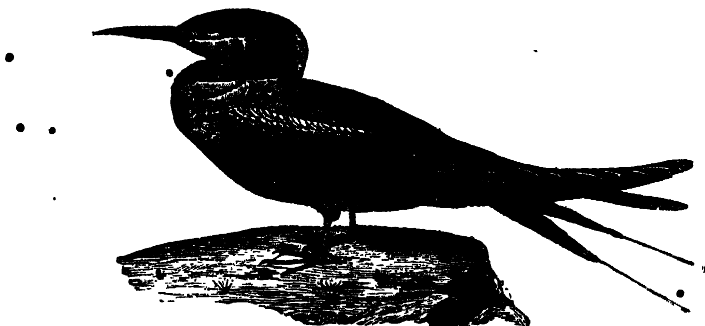


Fig. 9.—Great Tern, or Sea-Swallow (*Sterna Hirundo*).

are adapted for terrestrial motion, and the skin is covered with scales or bony plates.

The fourth class, the Birds (Aves), is composed of warm-blooded animals, in which the heart consists of four chambers; the limbs are always present, the anterior pair being adapted for flight, the posterior for terrestrial progression, and the skin is clothed with feathers.

The fifth and last class is composed of the truly viviparous Vertebrata, in which the young are nourished for a considerable time after birth by a peculiar secretion (milk), furnished by particular glands in the mother. Hence this class is denominated Mammalia. They resemble the Birds in their warm blood, and in the structure of the heart; but their limbs are almost always formed for terrestrial progression, and their bodies usually clothed with hair.



Fig. 10.—Lemur, with its young.

## Class I.—Pisces, or Fishes.

**General Characters.**—The animals of this class, as already stated, are exclusively aquatic, and all the particulars of their structure indicate an adaptation to this mode of existence. The head is large, and set upon the trunk without the intervention of any distinct neck; the body is usually of a spindle-shape, tapering gradually towards the posterior extremity; and the surface is usually smooth, without any irregularities which might impede the motions of the creature in its native element. In its general form the body is usually rounded, or slightly compressed at the sides; sometimes this flattening proceeds to a much greater extent, so that the animal presents the appearance of a broad band or oval disc, of which the edges correspond with the dorsal and ventral surfaces; in other cases the flattening takes place from above, downwards, producing a disc-like body, of which the upper and lower surfaces are dorsal and ventral.

Locomotion is always effected principally by lateral strokes of the hinder extremity, accompanied, in the elongated species, by an undulating motion of the whole body. In accordance with this arrangement, the great bulk of the body of a fish is made up of powerful longitudinal muscles, whose office is the flexion of the spine.

The skeleton exhibits a great diversity. In the lowest form of animal referred to this class, which has been described by some naturalists as an Annelide, and regarded by others as a transition form connecting the *Annelida* with the Fishes, the only trace of the vertebrate internal skeleton consists in a semi-gelatinous cord (the *chorda dorsalis*), which runs through the body of the animal, and supports the central axis of the nervous system, presenting, in fact, a great analogy with the earliest form in which the skeleton presents itself in the embryonic states of other Vertebrata. In the Lampreys, the development of the skeleton makes a little step in advance; the *chorda dorsalis* acquires a firmer or somewhat cartilaginous consistence, and, in some cases, exhibits slight indications of the segmentation of the vertebral column. In these animals,

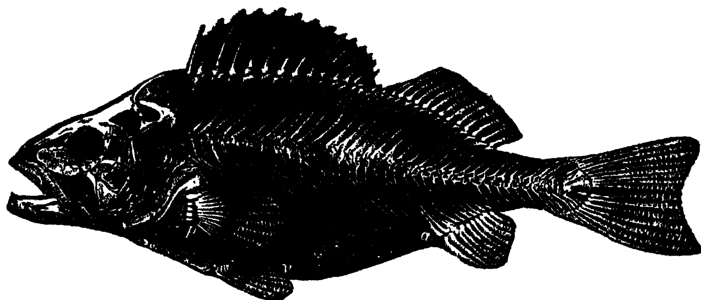


Fig. 11.—Skeleton of the Perch.

also, the brain is inclosed within a cartilaginous skull. As we advance, we find the skeleton gradually acquiring greater firmness, becoming first cartilaginous and afterwards bony. In some cases, however, the centre of the vertebral column retains almost its original consistency, when the peripheral parts have arrived at the state of cartilage.

In nearly all fishes which have the vertebral column in a bony or cartilaginous con-

dition, and formed of distinct vertebræ, the bodies of the latter are hollowed out, both before and behind, into conical cavities, the apices of which usually meet in the middle of the vertebra. These cavities are filled with a gelatinous matter, the remains of the embryonic *chorda dorsalis*. Only a single fish is known in which the ossification of the centres of the vertebræ proceeds further than this; this is the *Lepidosteus*, or Bony Pike of America, in which each vertebra is furnished with an anterior convex, and a posterior concave, articulating surface. The superior or neural arches of the vertebræ usually terminate in very long spinous processes. The inferior, or hæmal arches, exhibit a similar structure in the caudal region of the body, where they form a bony canal for the passage of the principal vessels, and, in a few instances, the same conformation extends into the abdominal region; but here we generally find a series of processes extending laterally from the bodies of the vertebræ, bearing ribs which inclose the abdominal cavity. The lower extremity of the ribs is always free, as there is no sternum for their attachment.

The structure of the skull, in Fishes, partakes of the variable character of the rest of the skeleton. In the lowest forms it is a nearly membranous expansion of the soft cord which here takes the place of the vertebral column, which gradually acquires cartilaginous supports. In the higher Fishes, with cartilaginous skeletons—such as the Sharks and Rays—the skull is a cartilaginous case, formed of a single piece; but in the bony fishes this becomes ossified from numerous centres, and the skull in these is usually of a very complicated construction. In most cases, however, the primitive cartilaginous skull is more or less persistent, so that in some instances the bony plates may be removed after the head has been boiled, leaving the brain for the most part still inclosed in its cartilaginous covering.

The skull of a bony fish (Fig. 12) is of very complicated structure, the number of bones of which it is composed being very considerable. The principal bones forming the cranium are the occipitals, the sphenoids, the ethmoid, the parietals, the frontals, and the temporals; the basi-occipital bone, forming the lower boundary of the aperture through which the spinal cord quits the skull, exhibits on its posterior surface the conical cavity which has already been described as characteristic of the body of the piscine vertebra, and articulates in the usual way with the first vertebra of the spinal column. The general form of the head is that of a pyramid with the base directed backwards; the orbits are placed on the sides, and the nasal apertures a little in front of them.

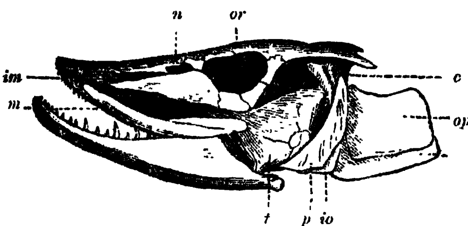


Fig. 12.—Bones of the head of the Pike.
*c*, cranium; *or*, orbit; *n*, nasal cavities; *im*, intermaxillary bone; *m*, superior maxillary bone; *t*, lateral partition, separating gills from mouth; *p*, *io*, *op*, bones of operculum, or gill-cover.

The upper jaw is formed of the maxillary and intermaxillary bones, of which the latter usually bear teeth, and form the actual margin of the mouth; whilst the former, as a general rule, are unarmed, and lie concealed in the flesh behind the intermaxillaries. These are bent back at an angle at their interior portion, so that they consist, in fact, of two branches, of which one serves, as just described, to form the biting edge of the mouth, whilst the other is received in a groove at the end of the nose,

in which it can move freely in those fishes which have a protrusible mouth. The palate is formed of three bones: the palatine bone, which is usually armed with teeth; the transverse bone, by which the palate is generally articulated to the cranium; and the pterygoid bone. The vomer also assists in the formation of the roof of the mouth, and is usually armed with teeth.

The two sides of the lower jaw are usually firmly united at the anterior extremity, but rarely joined by ossification. Each side is composed of several pieces, usually three, but sometimes four or more in number. Of these only one—the anterior—is furnished with teeth; the basal bone articulates with a sort of bony partition, formed of several bones immoveably articulated, which are also firmly attached to the skull in several places. The opercula, or gill covers, are also dependent from these bones. These are usually composed of four bony plates, of which the first—the preoperculum—is a somewhat crescent-shaped piece, extending from the cranium to the articulation of the lower jaw (Fig. 12); whilst the others, which are distinguished by particular names descriptive of their relative position, are moveably articulated to the preoperculum, and serve to close the branchial aperture. The relative size of these plates, their forms, and general structure, furnish the zoologist with excellent characters for the discrimination of genera and species.

Below these bones we find the hyoid arch, which attains a great development in fishes, and serves to support, not only the tongue, but also the respiratory apparatus (Fig. 13). From the front of this arch a peculiar bone (the *lingual* or *glossohyal*) penetrates to the apex of the tongue, where it is frequently covered with teeth. Behind this the hyoid bone forms two branches, each of which is attached to the preoperculum of its own side by a small bone called the *styloid* or *stylohyal*. To the side of each branch a variable number of slender-curved bones is articulated; these are called *branchio-stegal*; they support a membrane called the branchio-stegal membrane, whose office is to close the

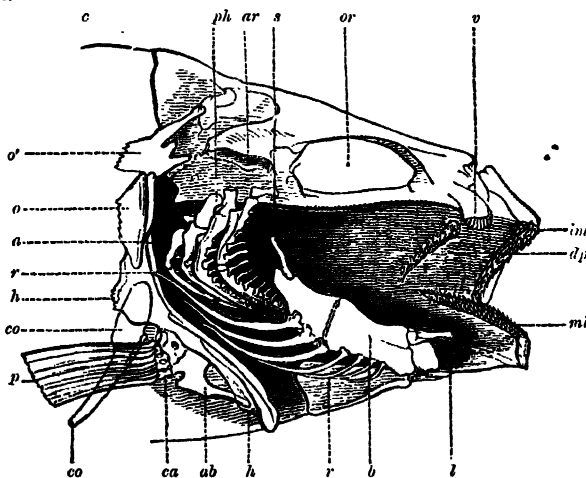



Fig. 13.—Bones of the head of the Perch, after the removal of the jaws, lateral partition, and operculum, on one side, to show the interior of the mouth, and the hyoid apparatus; *c*, cranium; *or*, orbit; *v*, vomer (armed with teeth); *im*, intermaxillary; *dp*, teeth implanted on the palatine arch; *mi*, lower jaw; *l*, lingual bone; *b*, lateral branches of the hyoid apparatus; *s*, process for the attachment of these to the lateral partition; *r*, *r*, branchio-stegal rays; *a*, branchial arches; *ph*, superior pharyngeal bones; *ar*, articular surface by which the lateral partition is attached; *o* to *h*, bony framework supporting the pectoral fin, *p*; *o* and *o'*, scapula divided into two pieces; *h*, humerus; *ab*, bone of the fore-arm; *ca*, bone of the carpus; *co*, coracoid bone.

gill-slit from beneath. Behind these, supported at one extremity upon the hyoid bone and articulated at the other to the bones of the cranium, are four pairs of bony arches, formed of two pieces in the cartilaginous fishes, but usually consisting of four in the bony species. On the outside these arches bear the branchial-laminæ, but their inner surface is usually armed with spines or teeth. They articulate with the cranium by small bones called the *superior pharyngeals*, which, like all the other bones in the neighbourhood of the mouth, are often armed with teeth.

The surface presented by Fishes to the surrounding element is greatly increased by the peculiar organs called *fins*. These are of two kinds. Some placed in pairs on the lower surface of the body are the analogues of the limbs of the higher vertebrated animals; whilst the others, situated single on the median line of the body, are to be regarded as appendages or developments of the cutaneous system. The former never exceed four in number; but one or both pairs are frequently absent.

These organs have received different names in accordance with their position on the body (Fig. 14). Of the two pair of fins corresponding with the limbs of other Vertebrata, one pair has received the name of *pectoral fins*, from their being situated on the breast immediately behind the branchial aperture; they are the analogues of the anterior members. The representatives of the hind limbs of other vertebrated animals are denominated *ventral fins*, their normal position being on the belly, close to the anus. These fins, however, are liable to great changes of position, being often advanced close under the pectoral fins, or even sometimes placed before these, quite on the throat of the animal The single or median fins are rather variable in number. The dorsal surface usually bears one or more of these organs, called *dorsal fins;* similar fins occur on the ventral surface behind the anus, called *anal fins;* and the extremity of the tail is almost always furnished with a broad expansion, the *caudal fin*, which is the pincipal agent in progression. In some fishes the median fins are continuous round the whole posterior portion of the body; and this is the condition in which these organs first make their appearance during the development of the embryo in all Fishes, the subsequent changes which take place in the arrangement of the parts being due to the unequal development of the bony rays which support and stretch the membrane of which the fins are composed. The structure and arrangement of the rays varies greatly in the different groups of Fish, and will be referred to hereafter.

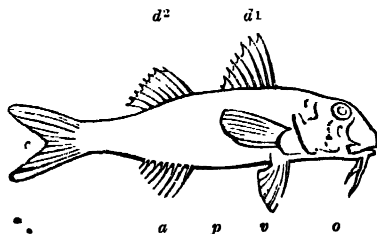


Fig. 14.—Bearded Mullet, showing position of fins; *p*, pectoral fin; *v*, ventral fin; $d_1$, first dorsal; $d_2$, second dorsal; *c*, caudal; *a*, anal; *o*, opening of gill-covers.

The pectoral fin in all fishes consists essentially of the same parts as the anterior limb of any other vertebrated animal. Concealed within the skin, immediately behind the branchial openings, we find a bony circle composed of several pieces, representing the shoulder blade, with the coracoid bone and clavicle (see Fig. 13); this supports the bones of the arm, which are usually very short, and bear a series of carpal bones at their extremity; the latter support a number of short cylindrical joints, from which the rays of the fin take their rise. The internal supports of the ventral fins never present such a close resemblance to the pelvis of the higher Vertebrata as do those of

the pectorals to the scapular arch. When situated in their normal position in the abdomen, they always consist of cartilaginous or bony pieces lying freely in the muscles and quite unconnected with the vertebral column; but when the fins are advanced from this position to the neighbourhood of the pectorals, their internal supports are attached to the scapular arch of the latter members.

The skin of the animals of this class is almost always protected by a covering of scales, which are sometimes of a horny and sometimes of a bony texture. Very few fishes are destitute of this scaly covering, which, however, is very variable in its distribution—its component parts being sometimes placed so close that one scale lies over the other like the tiles upon the roof of a house, sometimes fitted together exactly by their edges, and sometimes scattered irregularly over the surface of the skin. The differences in the form and structure of the scales is of great importance in the classification of Fishes; and Professor Agassiz even considers that they stand in such intimate relation with the general organization of the animals, that he has proposed to employ them as primary characters for dividing this great group into orders. This system has only been partially adopted by succeeding naturalists—as, although it is admitted on all hands that it has been of great service, especially in facilitating the study of fossil Fishes, there can be no doubt that it has the defect common to all systems founded upon characters derived from a single set of organs—that of separating nearly allied animals, and bringing others which have no mutual affinity into close juxtaposition. The most ordinary form is the thin horny scale, such as we meet with upon most of the common eatable fish. These consist of small horny plates, generally of a more or less oval form, which lie one over another, exactly like tiles, and are usually arranged in such a manner that each scale, being partially covered by two scales of the preceding row, only exhibits a somewhat triangular portion of its own surface. These scales are peculiar to the osseous fishes. They are found to consist of two layers, of which the lower is of a horny texture, whilst the upper resembles enamel. The scales are usually marked with concentric and radiating lines, of which the former appear to belong to the outer and the latter to the inner layer. In some Fishes they present a smooth outline—these are the *Cycloidei* (Gr. *kuklos*, a circle) of Agassiz; whilst in others, forming the order *Ctenoidei* (Gr. *kteis*, a comb) of the same author, the hinder margins of the scales are set with spines.

Another form of scale, exhibited by very few living species, although the Fishes of which it is characteristic were at one time almost the only representatives of the Vertebrata existing on our planet, is composed of a hard bony substance, covered with a coating of enamel, which often resembles the enamel of the teeth in structure. These scales are much thicker and larger than the horny scales, and are usually of a rhomboidal form, arranged side by side without overlapping, although, in a few instances, they resemble the horny scales in arrangement. The Fishes furnished with this bony armour are called *Ganoidei* (Gr. *ganos*, splendour) by Agassiz. In a third form the bony matter and enamel is distributed more or less irregularly over the surface of the skin; sometimes, as in the Sharks, projecting from all parts in the form of small grains, and sometimes, as in the Rays, forming larger discoid organs, from the centre of which acute spines, resembling teeth in their structure, frequently project. These are the *Placoidei* (Gr. *plax*, a plate) of Agassiz.

A line of peculiar scales, each of which is furnished with a minute tube, may be observed running along the sides of most fishes; it is called the *lateral line*, and its peculiarities are of considerable importance in the discrimination of genera and species.

The little tubes lead into a canal which follows the course of the lateral line, and which has been generally considered as subservient to the production of the slimy matter with which the surface of Fishes is usually so plentifully indued. It seems probable, however, that this slime is, in reality, the representative of the outermost layer of the skin, and that the so-called mucous ducts are connected with the exercise of some special sense, as they communicate with a very singular apparatus of tubes inclosed in the bones of the head, and furnished with a peculiar arrangement of nerves.

The colours of fishes are due to the presence of coloured fatty matters in the skin; but the beautiful metallic tints displayed by so many of them are produced by numerous microscopic plates, apparently of a horny nature, which are distributed over the surface.

In their nervous system, fishes exhibit a striking inferiority to the generality of vertebrate animals. The cranial cavity is small, but even this is only partially occupied by the brain, which is of very small size when compared with the body, or even with the other parts of the nervous system. It is distinctly divided into three parts, of which the anterior, representing the cerebral hemispheres of the higher Vertebrata, is usually small; whilst the middle division, from which the optic nerves take their rise, generally forms a considerable portion of the brain. In the Sharks, however, the general perfection of which contrasts strongly with the cartilaginous nature of their skeleton, the cerebral hemispheres generally predominate over the other parts of the brain (Fig. 15, B); and from this and other circumstances, these fishes appear to be entitled to take the first rank in the class, although zoologists generally, looking only at the imperfect ossification of their skeletons, have assigned them a very different position. The olfactory lobes constitute an interior prolongation of the brain, and are usually of very large size.

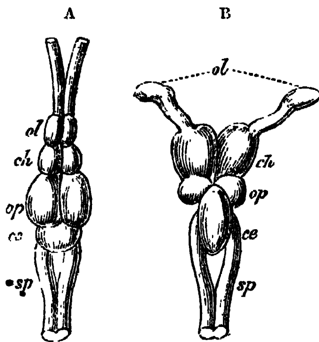


Fig. 15.—Brains of Fishes. A, Cod; B, Shark. *ol*, olfactory lobes; *ch*, cerebral hemispheres; *op*, middle brain, giving rise to optic nerves; *ce*, cerebellum; *sp*, spinal cord.

The organs of the special senses are, as usual, situated upon the head. The nose is usually formed by a double cavity lined with a folded membrane; each cavity opens on the snout by one or two apertures; but, except in one or two instances, there is no communication between the interior of the nasal cavity and the mouth, or pharynx. The eyes are large and flat, usually placed on the sides of the head, and furnished with six muscles for their movement. The auditory organ is completely inclosed within the bones of the head, and usually consists of a sac containing two otolithes, and a vestibule supporting three semicircular canals. In the Sharks, and their allies, we also find traces of a communication between the internal ear and the outer world. The sense of taste is probably by no means acute in fishes; and as their scaly covering must necessarily render their general surface rather insensible to external impressions, they are often furnished with special tactile organs, in the shape of filaments, surrounding the mouth (Fig. 14), or detached from the pectoral fins, which probably assist them in their search for prey.

A few fishes are furnished with a peculiar apparatus, which confers upon them the

singular power of communicating an electric shock to any animal with which they come in contact. The apparatus consists, in all cases, of a mass of gelatinous columns, separated by membranous partitions, which are richly furnished, both with vessels and nerves. The only fishes by which this curious property is undoubtedly possessed, are the *Gymnotus*, or Electric Eel of South America, the fishes of the genus *Torpedo*, and the *Malapterurus* and *Mormyrus* of the Nile.

The structure of the alimentary canal is often very complicated. There is scarcely a bone that assists in the formation of the oral cavity that is not often furnished with teeth, although these organs are usually developed upon particular bones. The upper jaw generally bears two parallel rows of teeth (Fig. 13), one attached to the intermaxillary bones, and the other to the palatine bones; the vomer also is commonly armed with teeth. The teeth in the lower part of the mouth are usually confined to the lower jaw and lingual bone. Besides these, the branchial arches and the superior and inferior pharyngeal bones are almost always furnished with teeth, forming a sort of trap at the entrance of the œsophagus. The teeth are not inserted into sockets as in man and many other Vertebrata; they are merely attached to the surface of the bone upon which they are supported. In some cases, they are simply imbedded in the skin of the mouth; in others they are attached by means of ligamentous filaments, and these are frequently moveable. In most fishes the teeth are constantly changing during the life of the animal, the older ones falling out to give place to others which are developed in their neighbourhood. They vary greatly, both in their external form and in their internal structure. The simplest form is that of a cone; but they are frequently compressed so as to constitute cutting organs, or widened into grinders. The conical teeth are often minute, and set very close together, so as to form a velvet-like surface.

The œsophagus is usually very muscular, and the stomach large. The pyloric aperture is generally furnished with a membranous valve; and behind the pylorus there are, in most bony fishes, a variable number (from one to sixty) of blind appendages, or *cæca* (called the *pyloric appendages*, or *cæca*), which are considered to be the representatives of the pancreas, which, in fact, occupies their place in the cartilaginous fishes. From this point the intestine is more or less convoluted in the abdominal cavity, until it terminates at the anus; in some Fishes the colon is furnished with a spiral arrangement of valves, serving to increase its surface. The anal aperture is usually placed at the posterior portion of the abdomen; but in many cases it is removed further forward, and sometimes even opens close under the throat. The liver is usually of great size; it is almost always furnished with a gall bladder, and the gall-ducts open into the intestine, close behind the pyloric aperture. The spleen is also invariably present.

Almost all Fishes are predaceous animals, attacking and destroying indiscriminately all the weaker inhabitants of the waters, such as Insects, Worms, Crustacea, and Mollusca, and preying with avidity upon the smaller individuals of their own class. Many of them are excessively voracious, seizing upon everything that comes in their way: these are always furnished with a formidable apparatus of teeth; others, which are not provided with such powerful offensive weapons, confine their depredations to the smaller and more helpless aquatic animals. Very few feed upon vegetable matters.

The respiration in all fishes is aquatic, and we meet with no instance of true lungs in any members of the class. Many species, however, possess a large sac-like organ, containing air, which, as it is often connected with the œsophagus by a tube,

must be regarded as to a certain extent analogous to the lungs of air-breathing Vertebrata. This sac, which is known as the *air-bladder*, has, however, nothing to do with respiration; it receives blood from the arteries and returns it into the veins, and the air which it incloses is probably derived from this fluid. Its office is to lessen the specific gravity of the fish, and it is furnished with a muscular apparatus, often of very curious construction, by means of which its capacity may be changed, so as to render the animal heavier or lighter than the surrounding medium.

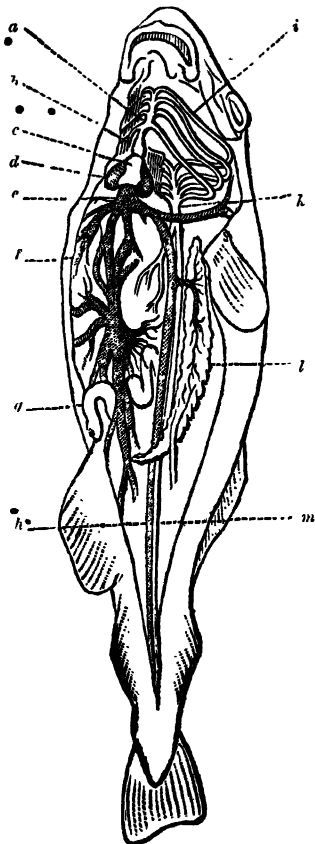



**Fig. 16.—Circulatory System of Fish.**
*a*, branchial artery; *b*, arterial bulb; *c*, ventricle; *d*, auricle; *e*, venous sinus; *f*, vena porta, liver, &c.; *g*, intestine; *h*, vena cava; *i*, vessels of the gills; *k*, dorsal artery; *l*, kidneys; *m*, dorsal artery or aorta.

The mechanism by which respiration is effected is as follows:—The gills are composed of a number of membranous laminæ, furnished with minute blood-vessels, and supported upon bony or cartilaginous arches, which surround the pharynx. These arches are separated from each other by slits; and the water which is drawn into the pharynx by a movement of deglutition, passes off through these slits, and escapes by the opercular aperture. These organs are fitted exclusively for aquatic respiration. Unless the gill-laminæ are surrounded by moisture, and, as it were, suspended in the surrounding medium, the majority of fishes soon die, from the clogging of those delicate organs and the rapid desiccation of their surface. Some species, however, are furnished with a special apparatus to keep their breathing organs moist when in the air; and a few others, which have no such provision, appear to be very little affected by a temporary absence from their native element.

With but a single exception, all fishes possess a muscular heart, which is situated under the throat, usually within the angle formed by the two sides of the scapular arch (Fig. 16). It is composed of two cavities,—an auricle, which receives the blood on its return from the body, and a ventricle, which drives it again into the system. The blood, on leaving the ventricle, passes through a main artery, which is usually bulbous at the base, and, in many fishes, is covered in the same part with a powerful muscular coat, and furnished with a valvular apparatus. From the continuation of this arterial bulb, which runs forward, the branchial vessels are given off on each side; these conduct the blood, which is still in the venous state, into the gills, where, in passing through the numerous capillary vessels with which the surface of those organs is covered, it comes in contact with the water, and undergoes that change which it is the object of respiration to produce in the blood. After passing through this network of minute vessels the blood is again collected in larger vessels, and

conveyed to the aorta, or principal artery, which runs down the whole length of the body immediately below the vertebral column, giving off branches to the various organs during its passage. After passing through the capillary vessels of the body the blood is again collected in the veins, which convey it into a great vein running up towards the heart, called the *vena cava*. In its course towards the heart a portion of the venous blood is, however, diverted into a peculiar system of veins, called the system of the *vena porta*, which ramifies through the substance of the liver; the kidneys are also supplied with venous blood. Thus the heart in Fishes acts both as a systemic and a respiratory heart, a single contraction of the ventricle serving to propel the blood not only through the vessels and capillaries of the respiratory apparatus, but also through those of the general circulation; whilst a portion of the fluid also passes through the capillaries of the liver and kidneys.

The last-mentioned organs are usually of very large size, and lie in the immediate neighbourhood of the vertebral column. The ureters are much branched at their origin, but afterwards unite to form a single canal, which often assumes the form of a bladder; and the secretion is discharged sometimes into the rectum and sometimes by separate apertures situated close behind the anus.

These animals are all essentially oviparous. The ovaries, well known under the name of *roe*, are generally of large size, and, when fully distended with ova, occupy a considerable portion of the abdominal cavity, which they often distend to a great extent. The number of ova contained in the ovaries of a single fish is often enormous. In most fishes the mature ova are carried out by means of an oviduct, which opens either into the last portion of the intestine or by a separate aperture immediately behind the anus. In a few the oviduct is wanting, and the ova, when ready to be deposited, break through the walls of the ovaries into the abdominal cavity, whence they escape by one or more apertures. The male organs occupy the same position as those of the female; they are commonly known as the *soft roe*. The mode in which their contents are evacuated presents much the same differences as in the female. As a general rule, the products of these organs are discharged at once into the water; the fish usually resorting in crowds to the same spot for the purpose of spawning, so as to secure the impregnation of the ova. This is evidently the object of the curious instinct which prompts so many fishes to undertake migrations in vast shoals, and often to great distances. The Herring, the Pilchard, and the Mackerel are examples of fishes which perform considerable journeys in search of a proper place in which to deposit their spawn. The Salmon is also very remarkable in this respect, from the pertinacity with which it continues its course from the sea, in which it habitually resides, in order to deposit its ova in the small streams near the sources of rivers. The spawning appears to take place only once a year.

Many fishes, however, are what is called ovo-viviparous; that is to say, the ova are retained within the oviduct until the complete evolution of the embryo. The mode in which the impregnation of the ova is effected in these cases is not exactly known.

Fishes appear always to select shallow water for the deposition of their ova; but, beyond this, they do not generally exhibit any care for their offspring. A few, however, form a sort of nest for the protection of their eggs and young; and in some instances, the male remains as a guard over the fry until they have acquired sufficient strength and agility to venture forth into the world. The little Sticklebacks (*Gasterosteus*), so common in all our ponds, furnish an interesting example of the exercise of this instinct.

**Divisions.**—The classification of Fishes has always presented considerable difficulties to the naturalist. Linnæus, who placed the cartilaginous fish amongst the Amphibia, divided the bony fishes into orders according to the position of the ventral fins; Cuvier founded his primary groups upon characters derived from the consistence of the skeleton (cartilaginous or bony), subdividing these into orders in accordance with the characters presented by the fins and gills; and Professor Agassiz afterwards proposed the system to which we have already referred, founded upon the structure of the scales.

The arrangement here followed is nearly identical with that proposed by Professor Müller in his valuable memoir on the Ganoid Fishes, published in the "Transactions of the Berlin Academy" for 1844, in which, by combining the systems of Cuvier and Agassiz, and making such alterations as his own extensive acquaintance with the animals suggested to him, he has succeeded in arranging the members of this difficult class in a far more satisfactory manner than any of his predecessors.

We divide the class of Fishes into five great orders.* In the first, the *Leptocardia*, the heart is entirely absent, and the circulation is effected by the pulsations of the great vessels. The vertebral column is represented by a gelatinous band supporting the spinal cord, and the latter exhibits scarcely any traces of cerebral organs at its anterior extremity. The fishes of the other four orders have a distinct muscular heart, composed of two chambers. In the first and second, the aperture leading from the ventricle into the artery is furnished with two valves, and the base of the artery is destitute of a muscular coating; in the others the valves at the entrance of the artery are wanting; but the inner surface of the latter is furnished with numerous valves, and its outer surface is clothed with a muscular coating. Of the former, the *Cyclostomata* are further distinguished by their cartilaginous skeleton, their sac-like branchiæ, opening by a series of apertures along the sides behind the head, and their round sucking mouth without jaws; whilst the *Teleostia* have a well-developed bony skeleton, a mouth furnished with jaws, and free branchial organs concealed under an operculum.

The *Ganoidea*, forming the first order of fishes with a muscular arterial bulb, resemble the Teleostia, in having free branchiæ, covered by an operculum. The skeleton in this order is sometimes bony, sometimes cartilaginous; and the skull is more or less covered with bony dermal plates. In the second order, the *Selachia*, the skeleton is always cartilaginous, the gills are fixed, the water used in respiration passing off through a series of openings, corresponding in number to the gills, and the head is never covered by bony plates.

In accordance with the views of Professor Owen, and many other naturalists, we have removed the Selachia (including the Sharks and Rays) to the head of the class, a position to which they are undoubtedly entitled, on account of the evident approach which they make, in many important particulars, to the higher groups of the Vertebrata. This alteration has also necessitated the removal of the Ganoid fishes, which in any system must occupy a position intermediate between the *Teleostia*, or bony, and the *Selachia*, or cartilaginous fishes.

Professor Müller includes a sixth group (the *Dipnoi*) in the present class, for the reception of the *Protopterus* and *Lepidosiren*—singular animals, which appear to partake almost equally of the characters of this and the following class. It has, in fact, long been a matter of dispute in which of these great groups these curious creatures should be placed; and we have preferred arranging them amongst the Batrachia, as they agree with those animals in possessing lungs and a pervious nasal cavity.

* Sub-classes of Müller.

### ORDER I.—LEPTOCARDIA.

This order includes only a single small fish, which rarely attains a length of two inches, but which presents so many remarkable characters that its title to a place in the vertebrate division of the Animal Kingdom has been disputed by some authors. This is the *Amphioxus lanceolatus*, a little, slender, transparent creature, which is found on sandy coasts in various parts of the world. Its body is of an elongated lanceolate form, with a narrow membranous border, running along the whole of the dorsal and a part of the ventral surface, and expanding at the caudal extremity into a lancet-shaped fin; which, however, is traversed by the tail itself. The vertebral column is represented by a gelatinous cord (*chorda dorsalis*), which supports the axis of the nervous system; the latter terminates anteriorly by a rounded extremity, without any signs of a brain. The head bears a pair of eyes, which are connected with the end of the nervous axis by short filaments; and between these is a small ciliated pit, apparently the first rudiment of an olfactory organ.

The mouth is placed at the front of the head, where it forms an oval opening, quite destitute of jaws, but surrounded by a number of cartilaginous points; the oral cavity leads into a large branchial sac, at the hinder extremity of which is the entrance of the intestinal canal. By the action of cilia, with which these cavities are lined, currents are produced in the water; and the water thus carried into the branchial sac, passing off through numerous slits in its walls into the general cavity of the body, whence it escapes by an opening in the ventral surface.

The circulation of the blood is effected entirely by the contractile power of the arteries; no trace of a muscular heart is to be detected in the transparent body of the creature. The blood itself, unlike that of all other Vertebrata, is perfectly colourless.

### ORDER II.—CYCLOSTOMATA.

**General Characters.**—The Cyclostomata still retain a good deal of the embryonic character so characteristic of the preceding order, although in their general organization they exhibit a very great advance.

They are of an elongated, cylindric, and somewhat worm-like form (Fig. 17), the skin is tough and quite destitute of scales, the pectoral and ventral fins are wanting, and the continuous fin, which runs round the posterior extremity of the body, contains scarcely any rays. The skeleton is cartilaginous, and consists simply of a dorsal cord and of a rudimentary skull, without any trace of ribs or other appendages. The mouth is destitute of jaws, and usually forms a circular sucking cup, supported by a curious cartilage. The inner surface of the mouth is often armed with teeth. The branchiæ are in the form of little sacs, on the inner surface of which the blood-vessels ramify. These usually open externally by separate orifices.



Fig. 17.—Lamprey.

The circulation of the blood in the Cyclostomata is effected, as in all the remaining fishes, by means of a muscular heart, composed of two chambers. The orifice through which the blood passes from the ventricle into the branchial artery, is provided with a pair of semilunar valves, and the base of this vessel is not furnished with a muscular coat.

**Divisions.**—This order contains only two families. In the *Myxinidæ*, the mouth is furnished with a number of cirri or tentacles, the lip bears a single tooth, and the tongue is sometimes armed with a few teeth. The eyes are completely concealed, and the nasal cavity opens into the mouth. These fishes appear to eat their way into the bodies of other fishes, in which they are often found by the fisherman. The best known species is the *Myxine glutinosa*, called the *Hag* by the British fishermen. It was described by Linnæus as a parasitic worm, and receives its specific name "glutinosa" from the immense quantity of mucus which it can give off from its skin, and which is said to be so great that if put into a vessel of water, it will, in a very short period, convert the whole of it into a glutinous mass, capable of being drawn out into threads.

In the second family, the *Petromyzonidæ*, the mouth has the form of a circular funnel, formed either of one or two lips. They are always destitute of cirri, but the inside of the mouth is usually armed with numerous teeth (Fig. 18). The nasal cavities never lead into the mouth, the eyes are usually well-formed, and there are generally seven branchial sacs, which open directly by a corresponding number of apertures along the sides of the body, whilst they communicate internally with the pharynx by the intervention of a common canal.

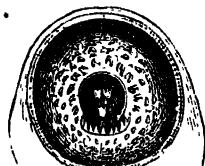


Fig. 18.—Mouth of the Lamprey.

This family includes the various species of Lampreys, which generally inhabit fresh water, although some species are found in the sea. They commonly adhere to stones in the water by means of their funnel-shaped mouth; and are said also to attach themselves, by the same means, to the bodies of other fishes so as to feed at leisure upon their substance. This statement, however, is very doubtful; and it appears more probable that the Lampreys derive their nourishment entirely from small aquatic animals.

The Sea Lamprey (*Petromyzon marinus*) attains a length of three or four feet. It quits the sea early in the spring, and proceeds up the larger rivers for the purpose of spawning; it is at this period that it is generally taken. In former days the Lamprey was regarded as a great delicacy; and one of our English kings is said to have died in consequence of indulging too freely in a dish of these fish. They have gone somewhat out of repute in the present day; but great numbers of the River Lamprey (*P. fluviatilis*) are still taken in some parts of Germany, where they abound, packed in jars with vinegar, spices, and bay leaves, and exported to other countries. Some epicures have resorted to the ingenious expedient of drowning Lampreys in wine; a process which is supposed to give them a very superior flavour. Formerly the River Lamprey was very abundant in the Thames, and its capture formed a most important part of the business of the Thames fishermen. They were sold in great quantities to the Dutch, to be employed as bait in the Turbot and Cod fisheries. Mr. Yarrell states that as many as four hundred thousand of these fish have been sold for this purpose in one season.

## Order III.—Teleostia.

**General Characters.**—The fishes of this order, which corresponds almost exactly with Cuvier's great section of *Osseous Fishes*, must be regarded as the types of the class. They are all furnished with a perfect bony skeleton (Fig. 11), the structure of which has already been described (page 10). The skull is always of a very complicated structure, and composed of numerous bones; the gills are supported upon free bony arches, and the water passes away from them by a single aperture, protected by a

bony operculum or gill cover. The mouth is always formed by a pair of regular jaws, and usually armed with teeth.

The arterial bulb, situated immediately in front of the ventricle of the heart (Fig. 16), is always composed of the thickened walls of the vessel, and is never provided with a muscular coat. The only valves in this vessel are a pair placed at the point where it communicates with the heart.

Many of these Fishes have a perfectly naked skin, but the majority are covered with scales of various forms. These are generally of a horny consistency, and exhibit the two principal types of form already described (p. 14), as *cycloid* and *ctenoid*. In some cases, however, the surface of the body is covered with bony scales and plates, which sometimes unite so as to form a complete suit of bony armour, presenting a considerable resemblance to that of the Ganoid Fish, amongst which the fishes thus protected were actually placed by Agassiz.

We have already stated that, besides the pectoral and ventral fins, the representatives of the anterior and posterior limbs, fishes are furnished with a series of perpendicular fins placed on the median line of the body, and denominated, according to their position, the *dorsal*, *caudal*, and *anal fins* (see p. 13, Fig. 14). The folds of skin of which these, as well as the pectoral and ventral fins, are composed, are extended by means of an apparatus of rays, which present themselves under two very distinct forms in the bony fishes—namely, as *spines* and *soft rays*. The former are simple, bony spines, tapering gradually to a point. They are generally stiff, and project, more or less, beyond the membranous part of the fin, so that, in some instances, they become dangerous weapons. The soft rays are also usually composed of bony matter; but instead of being composed of a single piece, like the spines, they are divided transversely into numerous short joints, and are also constantly dividing and subdividing longitudinally as they diverge from their point of insertion; so that, starting from the body as a single jointed ray, they become split up before reaching the margin of the fin into a bundle of smaller but similarly jointed branches. The soft rays are of universal occurrence throughout the series of bony fishes; the spiny rays occur in a great number, but are often absent. The spiny rays are to be found in all the fins except the caudal; they always occupy the anterior part of the fin, the remainder being composed of soft rays. In some fishes, with two dorsal fins (such as the Perch, Figs. 11 and 22), the first dorsal is often entirely supported by spiny rays; but in these cases we must consider the whole of the dorsal appendages as constituting one large fin. In some Fishes one or more of the spinous rays are completely separated from the fins. These are generally employed as weapons of offence and defence.

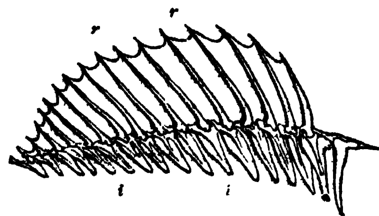



Fig. 19.—Dorsal Fin, supported on spiny rays, *r*, *r*, and these resting on interspinous bones, *i*, *i*.

The rays of the pectoral and ventral fins are, of course, articulated to the bones representing the anterior and posterior members, which, in fishes, are usually entirely concealed within the skin. The rays of the median or perpendicular fins articulate with a series of bones (Fig. 19), which are plunged into the median line of the body between the great longitudinal masses of muscles, and which, from their extremities passing in between the spinous processes of the vertebral column, have been denominated interspinous bones. Small

muscles, attached at one extremity to the interspinous bones, and at the other to the fin-rays, enable the fish to raise or depress the fin at pleasure. In some fishes a small, thick fin, without true rays, occurs behind the true dorsal fin; this is called the *adipose fin*.

**Divisions.**—This order includes a vast majority of the living species of Fish; and as the characters by which the genera and species are distinguished from each other are often by no means strongly marked, there are few groups of animals which present greater difficulties to the student than this. It is divided into numerous families, which may, however, be distributed under six sub-orders, although these are sometimes rather imperfectly defined.

### SUB-ORDER I.—PHYSOSTOMATA.

**General Characters.**—The fishes belonging to this group are usually furnished with a complete series of fins, which are always composed entirely of soft rays, with the exception of the first ray in the dorsal, anal, and pectoral fins, which are sometimes spinous. The ventral fins are sometimes wanting; when present, they are always *abdominal* in position,—that is to say, they are situated on the ventral region, behind the pectorals. There is never more than one *rayed* dorsal fin; but behind this there is occasionally a second adipose fin. The skin is sometimes naked, and sometimes more or less covered with bony plates; in most cases, however, it is thickly clothed with scales, which always exhibit the cycloid character.

The air-bladder is always connected with the pharynx by a sort of duct,—a most important character, as it only occurs in these fishes amongst all the *Teleostia*.

The *Physostomata* are exceedingly numerous, and inhabit both salt and fresh waters. They include amongst them some of the most important of the Fishes that are sought for by man as food; and also the only species of this order which possess electrical powers.

**Divisions.**—Professor Müller divides the *Physostomata* into two principal groups, the *Apoda*, in which the ventral fins are deficient, and the *Abdominalia*, in which they are placed on the belly.

The former—of which the common Eel is an example—are always soft-finned fishes, of an elongated, snake-like form, which often want both pairs of members, and in which the median fins usually present the same embryonic form as in the *Cyclostomata*, except that they are supported by distinct rays. The head is covered with a thick skin, which leaves only a small branchial opening. Within this is a large sac, from which a second sac is given off; and it is to this arrangement that these fishes are indebted for their power of supporting a long separation from their native element. They live both in the sea and in fresh water, where they swim along with an undulating movement of the body; they are exceedingly voracious animals.

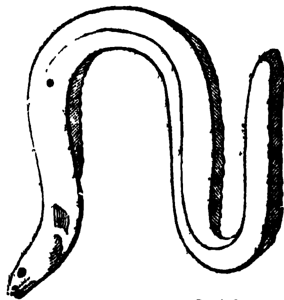


Fig. 20.—Gymnotus electricus.

The Apodal *Physostomata* form three families. Of these, the best known are the *Murænidæ*, or Eels, of which several species are eaten in this and other countries. They have the branchial apertures placed at the sides of the head, the intestine

without pyloric appendages, and the reproductive organs without efferent ducts. Many species of Eels constantly inhabit the ocean, whilst others usually live in fresh water, but migrate to the sea at particular periods, it is supposed to deposit their spawn. It is a very general belief that Eels are viviparous: but this is quite a mistake; and the opinion has, no doubt, taken its rise from the passage of intestinal worms through the anus. The marine species attain a large size, the common Conger of our coasts measuring sometimes as much as ten feet in length.

In the *Gymnotidæ*, the maxillary bones take part in the formation of the margin of the upper jaw, which is not the case in the *Murænidæ*. The branchial apparatus is situated as in the preceding family; the intestine is furnished with pyloric appendages; and the generative organs with efferent ducts. The dorsal fin is entirely wanting; but the anal fin is very long, running from the anus, which is situated near the throat, to the hinder extremity of the body.

The most remarkable fish of this family is the Electrical Eel (*Gymnotus Electricus*, Fig. 20), which frequents the ponds and marshy places of South America. This fish possesses a most wonderful power of communicating an electrical shock to anything with which it comes in contact; and this is said to be sufficiently strong to knock down a man, and deprive him of the use of a limb for some hours. The Electrical Eels attain a length of five or six feet; and, as the apparatus from which the electricity is evolved extends throughout the greater part of its body, it may readily be imagined that the discharge of such a battery must be a formidable affair. The apparatus is composed of four longitudinal bundles, placed one on each side of the dorsal and one on each side of the ventral region of the body. These bundles are composed of a multitude of horizontal parallel plates, which are intersected by transverse vertical plates, the quadrangular canals thus formed being filled with a gelatinous matter. The whole apparatus is liberally supplied with nerves, and may be considered to represent an exceedingly complicated galvanic battery. So powerful, in fact, is the current of electricity evolved by it that it can decompose chemical compounds, and magnetize steel needles. It appears that the anterior portion of the apparatus is positive, and the posterior negative; and that those parts of it only which are in contact with an object are implicated in the production of the current. Nevertheless, it is said that the animal can make use of it in benumbing small fishes at some distance from it in the water. The Indians of South America, when they wish to capture this fish, commence their operations by driving a number of horses and mules into the ponds inhabited by them; the eels, alarmed at the disturbance, immediately attack the intruders upon their quiet domain, usually applying their entire length to the bellies of the unfortunate quadrupeds, and thus giving the full effect of the whole electrical apparatus. Some of the horses soon become disabled, and falling down in the water, are drowned; the others, being driven back by the shouts and whips of the Indians, continue the conflict until the powers of the *Gymnoti* are, for the time, exhausted. These then endeavour, in their turn, to escape from the scene of warfare, and for this purpose approach the shore, where another enemy awaits them: the Indians, armed with harpoons attached to long cords, strike at all that come within reach, and by jerking them rapidly out of the water, so as to keep the cord from getting wet, contrive to secure their booty without receiving any shock. Several other species of this family are found in the waters of South America, but none of them appear to possess electrical properties. Mr. Wallace found ten species in the small streams near the sources of the Rio Negro and Orinoco; he says that they are all eaten, but that, owing to the number of forked bones which

they contain, they are but little esteemed. The Indians informed him that a rostrated species, common in those rivers, has a very singular and ingenious manner of obtaining its nourishment. They stated that its principal food consisted of ants and white ants, insects which are exceedingly abundant in those regions, and that, to procure them, it approached the shore and laid its tail upon the ground. The ants, attracted by the slimy matter with which this tempting morsel is covered, soon crawl thickly upon it, when the eel suddenly dives into the water, leaving its prey struggling on the surface, from which it can pick them off at its leisure.

The third family is that of the *Symbranchidæ*, in which the branchial apertures, instead of being placed at the sides of the head, as in the two preceding families, unite to form a single opening, often divided by a longitudinal partition, in the throat. They are all inhabitants of tropical countries, and live in fresh water.

Of the abdominal *Physostomata*, the first family contains only a single little blind fish, which is found in the subterranean caves of North America. The head is broad and rounded; the eyes completely covered by an opaque skin, or entirely absent; and the anus is situated on the throat in front of the pectoral fins. The young are brought forth alive. It forms the family *Amblyopsidæ*.

The fishes of the second family, the *Clupeidæ*, are always covered with large thin scales; the mouth is wide, and both the maxillary and intermaxillary bones assist in the formation of the margin of the upper jaw. The dorsal fin is single, and there is no adipose fin. Most of them are furnished with pyloric cœca and air-bladders.

This family includes some of the most important of all fishes, in an economical point of view. Of these the best known and most valuable is the Herring (*Clupea Harengus*), which occurs in vast abundance upon our coasts, between the months of July and November, and, during this period, gives employment to multitudes of fishermen and whole fleets of vessels. It has long been a generally received opinion that the Herring, when it disappears from the immediate neighbourhood of our coasts, undertakes a long migration to the Arctic Seas, where it is said to find an abundant nourishment in the vast swarms of minute Crustacea with which the waters of those seas are known to abound. This notion appears to rest principally upon the authority of Pennant, who particularly described the supposed line of migration, and states that the mass of Herrings, on their way southwards towards their spawning grounds, meets its first obstruction at the Shetland Isles, which divide the army into two parts, of which one passes down the eastern and the other down the western shores of our islands. Unfortunately for this theory, however, it appears that the Herring, if not wholly unknown, is at least an exceedingly rare fish in the Arctic Seas, whilst, on the other hand, specimens may be taken at all seasons in the neighbourhood of the European coasts.

From the statements of several observers, it appears certain that the Herrings inhabit the European seas at all seasons, keeping in deep water during the winter and spring months, and that the appearance of the vast shoals at particular epochs, which has given rise to the idea of their performing a long migration, is due only to their seeking the shallow waters for the deposition of their spawn. During their migrations for this purpose they swim close to the surface of the water; and so enormous are the crowds of fish which thus, animated by a common impulse, swim together in the same direction, that the sea for miles exhibits a silvery appearance, from the glittering of their brilliant scales.

The principal seat of the Herring fishery in this country is at Yarmouth, in

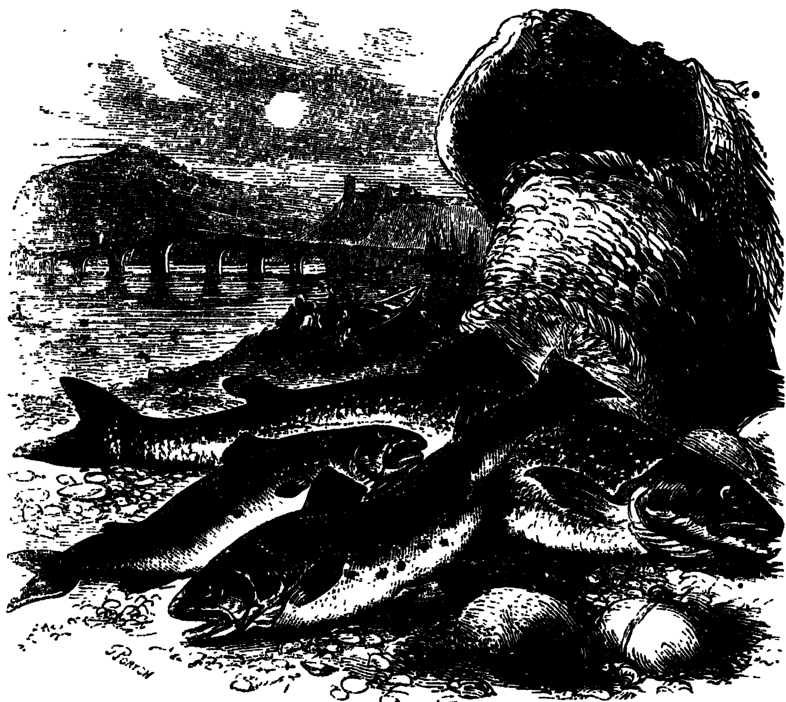


Fig. 21.—Trout (*Salmo fario*), and Salmon (*Salmo salar*).

the marked fish have been taken ascending rivers in the neighbourhood of that in which they were spawned. It is, nevertheless, singular and unaccountable that after wandering for miles along the coast, so many of these fish should be able to find their way back to their native streams, the extent of their excursions being abundantly proved by the numbers which are taken in bays along the coast, at a distance from any considerable Salmon river. It is said that the stomachs of Salmon taken in fresh water are never found to contain any food, and hence many people have concluded that the fish do not feed at all during their sojourn in the rivers. It is certain that during their stay in fresh water the fish fall off greatly in condition, and that they are in their greatest perfection at the period of their commencing their ascent. In the sea they appear to feed principally upon small Crustacea, the remains of which are usually found in their stomachs, accompanied by a reddish matter which has been described as the spawn of an *Echinus*. The young Salmon remain in the rivers until they attain about a foot in length, when they descend to the sea.

The principal European Salmon fisheries are at the mouths of the larger rivers in the British Islands; and of these the Tweed, the Tay, and the Severn fisheries are the most important. The Thames was formerly much famed for Salmon, but in consequence



Fig. 22.—GRAYLING (*Thymallus vulgaris*), and PERCH (*Perca fluviatilis.*)

of the increasing impurity of the water, this fish has now become scarce in that river. A considerable number of Salmon are also taken on the Norwegian coast.

Another species of Salmon (*Salmo Rossii*) is found in great abundance in the Arctic Sea, at the mouths of the rivers which fall into that ocean from the northern portion of the American continent. This fish occurs in such vast shoals, according to Dr. Richardson, its discoverer, that during one of the arctic expeditions as many as 3,378 were obtained at one haul of a small sean. It is of a more slender form than the common Salmon; the under jaw is very long and projects considerably in front of the upper, and the scales are small, and separated from each other by a bare space of skin. The sides are adorned with numerous bright crimson spots.

Several other species agree with the Salmon, in choosing the sea as their habitual residence, and ascending the rivers at the spawning time; of these a well-known British species is the Salmon Trout (*S. trutta*). Of those which are confined to fresh water, one of the best known is the common Trout (*S. fario*, Fig. 21), which frequents most of the rivers and lakes of Europe, and is one of the fish most prized by the angler; its caution rendering it very shy of taking a bait, whilst its great strength and activity make it by no means an easy task to land a good Trout when hooked. The

Trout is shorter and stouter than the Salmon; the colour of its back is a yellowish brown, passing to yellow on the sides, and silvery on the belly; the back is spotted with reddish brown, and the sides with bright red. Several nearly allied species are found in the rivers and lakes of Europe, especially in mountainous countries. Of these, we need only mention the Char (*S. salvelinus*) and the Grayling (*Thymallus vulgaris*, Fig. 22), both of which occur in our own country. The Smelt (*Osmerus eperlanus*) also belongs to this family. It is a small, semi-transparent, silvery fish, which resembles the salmon in its habits, keeping about the mouths of large rivers, which it ascends for the purpose of spawning.

Close to the *Salmonidæ* Professor Müller places a small family, the *Galaxiidæ*, which he has established for the reception of a single genus of fishes (*Galaxias*), placed by Cuvier amongst the *Esocidæ*, or Pikes. They agree with the Salmons in their general structure, and in the mode in which the ova are excluded, and are distinguished principally by the absence of the adipose fin, and the want of scales.

In the *Esocidæ*, the biting edge of the upper jaw is formed as in the *Salmonidæ*, both by the maxillary and intermaxillary bones; but the adipose fin and the pyloric cœca are wanting. The mouth is furnished with a most formidable apparatus of teeth; almost all the bones which assist in the formation of that cavity being thus armed.

All the known fishes of this family inhabit fresh waters, and only occur in temperate climates. They are of an elongated form, clothed with cycloid scales, and furnished with powerful fins, their whole conformation being eminently adapted for that rapid motion through their native element, without which their voracious propensities would stand but a poor chance of gratification. The only fish now placed in this family are the true Pikes (*Esox*), and a few small fishes forming the genus *Umbra*, of which one species is found in the rivers of Austria. The Pikes, of which the common Pike (*Esox lucius*), of this country may be taken as an example, are amongst the most voracious of fresh-water fishes, seizing and devouring objects which at first sight would appear far too large even for their capacious mouths. Numerous anecdotes are related of the voracity of the Pike. No fish that they can swallow are safe for a moment in their neighbourhood, although it is said that the spiny back fin of the Perch often saves him from being gorged. Young Ducks are frequently dragged under by Pike; and an instance is related of one of these fish having seized the head of a swan as the bird was in the act of dipping. Salter states that he has frequently known Pike seize upon the plummet with which some quiet bottom-fisher was taking the depth of his water; and in one case he succeeded in landing a fish of about two pounds that had snapped at this indigestible bait.

The Pike, when full grown, is a large fish, often attaining a weight of thirty or forty pounds; and individuals of double this weight have occasionally been taken. Its longevity is also very remarkable, if we may place implicit faith in a statement of Gesner, that a Pike was taken in the year 1497, in Suabia, with a ring attached to it, on which was an inscription, to the effect that the fish had been put into the lake in which it was found, by the Emperor Frederick II., in the year 1230, or two hundred and sixty-seven years before its final capture. This patriarch of the lake is said to have measured nineteen feet in length, and its skeleton was long preserved at Manheim. Cuvier placed several other genera in this family, but these have been removed to other groups, with the exception of the genus *Salanx*, the position of which is still very doubtful.

Nearly allied to the Pikes is a small family of fishes, the *Mormyridæ*, the members

of which have hitherto only been found in the Nile, and, according to Cuvier, in the Senegal. They resemble the *Esocidæ* in the form of the body and the position of the fins, and the maxillary bones assist in the formation of the edge of the upper jaw, but the intermaxillary bones are completely united in front, so as to form a single bone, without any trace of suture—a structure which does not occur in any other fishes. The mouth is small, the arrangement of the teeth varies, and the pylorus is furnished with two cœca. The air-bladder is simple. The skin of the body is covered with scales, but the head is clothed with a thick, naked skin, which incloses the opercula, and only leaves a small perpendicular branchial aperture, presenting a considerable resemblance to a spiracle. The sides of the tail are thickened, and contain a small electrical organ. The *Mormyri* of the Nile are reckoned amongst the best fish produced by that river.

The great family of *Cyprinidæ*, or Carps, which includes the greater number of the fresh-water fishes of temperate climates, is distinguished by its small mouth and toothless jaws, of which the upper is entirely composed of the intermaxillary bones. To make up for the want of teeth in the mouth, the inferior pharyngeal bones are armed with very powerful teeth, which work against a singular process of the lower part of the skull, covered with horny plates. The body is usually compressed, and always clothed with scales, sometimes of very large, sometimes of very small size; the head is small; the dorsal fin is single, and there is no adipose fin, but in some cases the dorsal and anal fins have a single toothed spinous ray. The air-bladder is usually divided by a constriction into two parts, and communicates with the labyrinth of the ear by a series of small bones; the intestine is destitute of cœca.

The fishes of this family are found in great abundance in all the fresh waters of Europe. Many of them are much sought after by anglers; but rather for the sake of sport than for the goodness of their flesh, which is usually watery and insipid. In former times, however, when the transportation of marine productions, in a fresh state, to great distances from the coast was attended with greater difficulties than in the present day, these fish were regarded as of some importance, especially as a change from the salt fish diet to which many good Catholics were condemned during Lent.

The *Cyprinidæ* feed principally upon aquatic plants and worms; but a few of them seem occasionally to prey upon small fishes. One of the finest and best of the European species is the Carp (*Cyprinus carpio*), to the breeding of which in ponds great attention is still paid in many places, although in this country the abundant supply of sea fish has rather thrown it out of favour, except amongst anglers. Another fish belonging to this family, which is a great favourite with the disciples of Walton, although its flesh is far inferior to that of the Carp, is the Barbel (*Barbus vulgaris*). It is one of the largest species, measuring sometimes as much as three feet in length, and is exceedingly abundant in all the larger rivers of this country. Its name appears to refer to the great length of the tentacles surrounding the mouth, which it possesses in common with several other species of *Cyprinidæ*. These tentacles are also very long in the Loaches (*Cobitis*), a group of small fishes belonging to this family.

Many *Cyprinidæ* are distinguished by the beautiful silvery hue of their bodies; they form the genus *Leuciscus*, of which the Roach (*L. rutilus*), the Dace (*L. vulgaris*), the Chub (*L. cephalus*), and the Bleak (*L. alburnus*) are species well known to anglers. The scales of these fish, and especially those of the Bleak, are said to be employed in the manufacture of artificial pearls. The beautiful gold and silver fish (*Cyprinus auratus*) of China, which are now completely naturalized in this country, also belong to this family.

Nearly allied to the *Cyprinidæ* are two small families, the *Pœciliidæ* and the *Characinidæ*. The fishes of the former of these families resemble the Carps so closely in their general form and in the position of their fins, that they were formerly included with them in the same family. They differ from the *Cyprinidæ*, however, in having both jaws armed with numerous small teeth; the large pharyngeal teeth and the cranial plate of the Carps are replaced by teeth of the same form as those of the mouth; and the air-bladder is simple, and presents no traces of the series of bones communicating with the ear. They are all small, scaly fish, inhabiting the fresh waters of warm climates. In some of them the oviduct is dilated into a sac, in which the eggs are retained until the young are hatched, so that the fish brings forth living young. In some curious little fish belonging to this family, forming the genus *Anableps*, the cornea and iris of each eye are divided into two parts by transverse bands, which give the creature the appearance of having four eyes, although all the inner portions of the eye are single. The best known species is the *Anableps tetrophthalmus*, or Four-eyed Loach, a native of the rivers of Guiana.

The *Characinidæ* appear to be intermediate between the *Cyprinidæ* and *Salmonidæ*, with the latter of which they were placed by Cuvier. Like these, they have usually a small adipose fin on the back behind the true dorsal fin; the upper jaw is composed of the maxillary and intermaxillary bones, and the jaws are usually furnished with teeth; and the pyloric cœca are numerous; but the ovaries are provided with continuous oviducts, and the air-bladder is divided into two parts, and communicates by a series of bones with the auditory organs. These fishes are found in the rivers and lakes of tropical countries, where some of them attain a considerable size. A few are very voracious; the *Serrasalmones* of the South American rivers are said to seize upon water-fowl, and even to attack men when bathing in the rivers.

This sub-order is closed by the curious family *Siluridæ*, including fresh-water fishes, usually of considerable size, of which the skin is either naked or more or less covered with bony plates, especially about the head. The mouth is usually furnished with teeth, and always surrounded by tentacles; the edge of the upper jaw is formed entirely by the intermaxillary bones, and the opercula are formed only of three pieces. All the fishes of this family possess an air-bladder, which is connected with the ear by a series of small bones. The first ray of the pectoral fins is usually converted into a strong spine, which constitutes a formidable weapon; and the wounds inflicted by this have often been considered venomous, although apparently without any sufficient foundation. The dorsal fin is often very large; but in some species the rayed dorsal is entirely deficient, and its place is supplied by an adipose fin.

These fishes are, for the most part, confined to the rivers and lakes of tropical climates; only a single species (*Silurus glanis*) is found in the European waters, but this often attains a length of from six to eight feet, and weighs several hundred-weight. They swim slowly, and appear to take their prey by concealing themselves in the mud and lying in wait for the approach of any unlucky fish—a proceeding which is greatly favoured by their dark colour.

A species inhabiting the rivers of Africa, especially the Nile and the Senegal, the *Malapterurus electricus*, which attains a length of twelve or fifteen inches, is remarkable from its possessing electrical properties, although in a comparatively slight degree. Some nearly allied species inhabiting South America, which have the whole body covered with an armour of bony plates, and in which the air-bladder, with its series of bones, is entirely wanting, have been formed into a distinct family under the name of *Loricariidæ*.

## SUB-ORDER II.—ANACANTHINA.

**General Characters.**—The sub-order of *Anacanthina*, or *spineless* fishes, presents a considerable resemblance to the preceding group; the fins are entirely supported upon soft rays, and even the single spine, which occasionally occurs in some of the fins of the Physostomatous fishes, is wanting here. Like the Physostomata, these fishes are also divisible into two groups, characterized by the presence or absence of the ventral fins; but these organs, when present, are always placed on the chest or throat, and supported by the same bony arch which bears the pectoral fins.

They also present an important difference in the structure of the air-bladder, which, instead of communicating with the œsophagus by a duct, as is the case in the Physostomata, is here completely closed; and, as a general rule, the duct, which exists in the embryo, has entirely disappeared, so that there is no connection between the anterior part of the air-bladder and the œsophagus. The inferior pharyngeal bones are always separated.

**Divisions.**—The Anacanthina constitute four families, of which two are destitute of ventral fins (*Apoda*), whilst the others have these organs placed in the neighbourhood of the pectorals (*Subbrachiata*). The apodal species usually agree very closely with the Eels, not only in the absence of the ventral, and sometimes of the pectoral fins, but also in the general form of the body, which is elongated, and often serpentiform; they may, however, always be distinguished from the apodal Physostomata by the greater freedom of the opercular apparatus, which is never inclosed in a thick skin, as in the eels.

The first family, the *Ammodytidæ*, is further distinguished from the Eels by the form of the caudal fin, which is well developed, distinct from the dorsal and anal, and considerably forked at the extremity. The skin is naked, but of a beautiful silvery lustre; the dorsal fin commences a little behind the head, and runs nearly to the root of the caudal fin; the anal fin extends about a third, or one half, the length of the body; and both the dorsal and anal are supported upon soft, but simple rays.

There are two British species, which are much used by the fishermen as baits for other fish. They are known by the names of *Sand-lances*, or Sand-eels, from their habit of burying themselves in the sand, to a depth of six or seven inches, during the ebb of the tide, generally selecting for this purpose those parts of the beach which are left dry at low water; it is in this position that they are generally taken by the fishermen, who rake them out by means of iron hooks and rakes. The largest British species (*Ammodytes Tobianus*) usually measures about a foot in length; the smaller one (*A. lancea*) only five or six inches.

In the *Ophidiidæ* the eel-like form makes its appearance with still greater distinctness: as in the Eels, the median fins are continuous, forming a border round the hinder extremity of the body; the caudal fin is rounded or pointed, but never forked, and the pectoral fins are sometimes wanting. The body is sometimes naked, sometimes covered with minute scales imbedded in the skin; the anus is situated sometimes in the middle of the body, sometimes under the throat; and the air-bladder is always present, and quite destitute of a duct. These are generally small fishes, inhabiting only the sea; several species are found in the Mediterranean, and two or three have occurred upon the British coasts.

The *Subbrachiate* Anacanthina, or those with ventral fins attached to the breast or throat, include two families of fishes which are of the greatest importance as articles of food—the *Gadidæ*, or Cod family, and the *Pleuronectidæ*, or Flat-fishes.

In the former the body is of an elongated spindle-shape (Fig. 5), produced behind into a long tail; the skin is usually furnished with very small soft scales, which are entirely inclosed in separate sacs; the median fins are of very large size, and usually divided into several portions; the mouth is wide, furnished with numerous small teeth, and the margin of the upper jaw is entirely formed by the intermaxillary bones. The lower jaw is frequently furnished with a single cirrus, or beard, beneath its extremity, and the nose sometimes bears one or two pairs of similar appendages; the ventral fins, also, are sometimes reduced to a single ray, so as to acquire the appearance, as they no doubt perform the office, of cirri; and these in some species (such as the Forked Hake —*Phycis furcatus*—of our own coasts) are of considerable length, and give off a branch from about their middle, which is sometimes longer than the main stalk.

The Gadidæ are active and exceedingly voracious fishes, feeding indiscriminately upon almost all the smaller aquatic animals. Mr. Yarrell states, that "Mr. Couch has taken thirty-five crabs, none less than the size of a half-crown piece, from the stomach of one Cod." They are nearly all marine; their flesh is exceedingly firm and well-flavoured; and as many of the species occur in the greatest profusion, their importance, in furnishing an abundant supply of agreeable and nutritious food to the human race, is almost incalculable. The principal species found in our markets are the Cod (*Morrhua vulgaris*), the Haddock (*M. æglefinus*), the Whiting (*Merlangus vulgaris*), and the Ling (*Lota molva*); but many others are taken on various parts of the coast, although they rarely find their way to London. These fishes are all taken by hook and line, baited with common Mollusca, such as limpets, whelks, &c., or with pieces of fish. For the deep-sea fishing very long lines are used; these are fixed to the bottom by means of a small anchor, the other end being supported by a buoy, and the hooks are placed at the extremities of short lines, usually about six feet in length, attached at intervals to the main line. The long lines are usually left for about six hours, or for a whole tide, when they are taken up and examined. In the interval the fishermen are not idle; they carry on the work of destruction by means of hand-lines, of which each man manages a pair. In this manner an immense quantity of these and other valuable fish are taken at almost all parts of the British coasts. Mr. Yarrell states, that "from four hundred to five hundred and fifty cod-fish have been caught on the banks of Newfoundland in ten or eleven hours by one man," and mentions that he was informed by a master of fishing-vessels for the London market, "that eight men, fishing under his orders off the Doggerbank, in twenty-five fathoms water, have taken eighty score cod in one day."

Besides the consumption in a fresh state, several species of this family are commonly preserved by drying, either with or without salt; of these, the most important are Cod, Haddock, and Ling.

In spite of the enormous consumption constantly going on, the numbers of these fish do not appear to decrease; and this, perhaps, is the less to be wondered at, when we consider that the roe of a single female Cod has been found to contain no fewer than nine millions of ova. Their general spawning time appears to be the winter, or very early in the spring; they are full of roe, and in their greatest perfection during the early winter months.

The species of Gadidæ appear to be principally confined to the seas of the northern parts of the world; the common Cod is distributed from Iceland to the coasts of Spain, without entering the Mediterranean, and most of the other species abound especially in northern latitudes. One species, the Burbot (*Lota vulgaris*), nearly allied to the Ling,

is found in the rivers and lakes of several countries of Europe and Asia. It is of an elongated form, and presents considerable resemblance to the Eel in its habits, from which circumstance it is called the Eelpout in some places. It inhabits a few English rivers, but is not generally known, although its flesh is said to be most excellent.

The family of *Pleuronectidæ*, or Flatfish, which concludes the present sub-order, consists of numerous fishes, which, in their general appearance, are remarkably different from those of the preceding groups, and indeed from all other fishes. They have a broad, flat body, margined almost throughout by long dorsal and anal fins; the head is singularly twisted, so that the eyes are both brought to one side of the body, and this, which is always uppermost, is usually of a dark colour, and often spotted, whilst the opposite side is always white. These surfaces are often regarded as the back and belly of the fish, but incorrectly; the gill openings and the paired fins being situated on both surfaces, the pectorals a little behind the apertures of the gills, and the ventrals in front of these on the throat (Fig. 23). The abdominal cavity is very small, and the anus opens under the throat, so that, as remarked by Professor Vogt, the whole body is nothing but an exceedingly compressed, disc-like *tail*. The mouth is small, and armed with small teeth, and in most species the skin is covered with ctenoid scales.

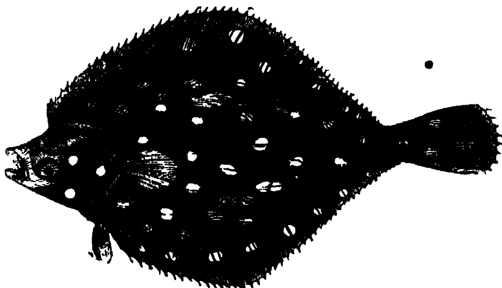


Fig. 23.—The Plaice (*Platessa vulgaris*).

The Flatfishes swim with the dark side uppermost, and with a sort of undulating motion of the whole body; they generally keep close to the bottom of the water, where they feed upon small fishes, mollusca, worms, crustacea, &c. Some species attain a large size; the Holibut (*Hippoglossus vulgaris*) is said sometimes to weigh as much as five hundred pounds; and a specimen measuring "seven feet six inches in length, three feet six inches in breadth, and weighing three hundred and twenty pounds, was taken (in April, 1828) off the Isle of Man, and sent to Edinburgh market"—(*Yarrell*). The Turbot (*Rhombus maximus*), which is regarded as the finest fish of this family, does not appear to reach quite such gigantic dimensions; the largest recorded by Mr. Yarrell weighed one hundred and ninety pounds, and measured six feet across.

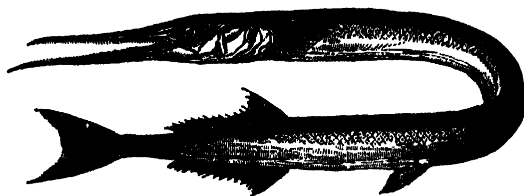
These fish are caught either by means of hooks and lines or by the trawl-net; the former method is employed during the warmer months of the year. The species most esteemed are the Turbot and the Sole (*Solea vulgaris*); but several others, although inferior in the quality of their flesh, are of great importance, as they are caught in such numbers that they can be sold at a very cheap rate. Of these the best known are the Plaice (*Platessa vulgaris*, Fig. 23), the Brill (*Rhombus vulgaris*), and the Flounder (*Platessa flesus*).

All the Pleuronectidæ are inhabitants of the sea, although they sometimes ascend the brackish waters of tidal rivers; and the Flounder even appears capable of thriving in perfectly fresh water. They are rather voracious fishes; and, in spite of their singular form, are often very active in their habits. They conclude the sub-order Anacanthina.

## Sub-Order III.—Pharyngognatha.

**General Characters.**—This sub-order includes an assemblage of fishes which undoubtedly present a very great diversity of form, and in which we not only meet with species in which all the fins are supported upon soft rays, but also with others which possess spinous rays as strong and well developed as those of any fishes belonging to the remaining groups. The principal character which serves to unite the Pharyngognatha is derived from the structure of the inferior pharyngeal bones, which, in all the fishes of this sub-order, are completely coalescent, so as to form a single bone, which is usually armed with teeth. So complete is the union in most cases, that no trace of the original separation of the bones can be discovered. In other respects, it must be confessed that the fishes referred to this order present but few characters in common; the fins, as already stated, are sometimes entirely composed of soft rays (*Malacopterygii*, Müller), sometimes partially spinous (*Acanthopterygii*, Müller); the ventral fins are sometimes placed on the belly, sometimes on the chest or throat, and the scales are cyloid in some species, ctenoid in others. The air-bladder is always completely closed.

**Divisions.**—Professor Müller divides the Pharyngognatha into two groups, for which he adopts the names of *Malacopterygii* and *Acanthopterygii*, proposed by Cuvier for his primary divisions of osseous fishes. The former group, including the soft-finned species, contains only a single small family, the *Scomberesocidæ*, so called from the mingled resemblance which the fishes composing it appear to bear to the Scomberos, or Mackerels, and the Esoces, or Pikes. They are usually of an elongated form, and clothed with cycloid scales. The dorsal and anal fins are placed far back, and a series of small fins often intervenes between these and the caudal fin; the ventral fins are placed on the abdomen, and the pectorals usually removed far back, and often of considerable size. In the true Flying-fishes (*Exocœtus*), which belong to this family, the pectoral fins attain a great length, and possess sufficient force to serve the fishes as wings, upon which these creatures can rise from the water, and support themselves in the air for a considerable space. One species of flying fish, the *Exocœtus exiliens*, inhabits the Mediterranean, and has been found dead on the south coast of England; a second smaller species is found in the ocean, especially in the tropical parts of the world.


Fig. 24.—*Belone vulgaris.*

The flying fishes exhibit a good deal of the form of the Herring, and, like it, are covered with tolerably large scales; but in the typical species of the family the body is very long, and the texture of the surface resembles that of the Mackerel. These also present the conformation of the jaws which has led to their comparison with the Pike, and even to their being included amongst the Esocidæ by many ichthyologists. The jaws are much produced, forming a slender snout, not unlike that of the Gangetic

Crocodile, and are often armed with strong teeth. In the genus *Hemiramphus* the lower jaw only is produced in this manner; hence these fishes have received the name of the *Under Swordfish.*

The fishes of this family inhabit the sea exclusively; and several species are taken on our coasts, where they are commonly known by the names of Garfish, Sea-pike, Sea-needle, &c. The commonest species, *Belone vulgaris* (Fig. 24) is sometimes called the Mackerel-guide, from its generally preceding the shoals of Mackerel when they visit the shallows for the purpose of spawning; it is also denominated Green-bone in some places. It, and its allies, are but little esteemed as food, although they may occasionally be seen even in the shops of the London fishmongers.

The Acanthopterygious, or spiny-finned division of this sub-order, is characterized by the possession of a single long dorsal fin, of which the anterior portion is spinous, the posterior supported only on soft rays. Near the extremity of each of the spinous rays there is usually a small membranous appendage; and the ventral fins are generally placed upon the breast or throat. Most of them are handsome fishes, frequently most beautifully variegated with brilliant colours; and some are remarkable for the eccentricity of their forms. They form three families.

The *Chromidæ* are characterized by their fleshy lips, and by their interrupted lateral line, the anterior portion of which terminates about the middle of the body, whilst the posterior portion commences where this disappears, but at some distance below it. The greater part of the dorsal fin is spinous, and the spines are usually furnished with membranous appendages; the head and body are covered with ctenoid scales; the edge of the preoperculum is almost always smooth; the inferior pharyngeals are united by a suture; and the laminæ of the fourth branchial arch are of equal length. The stomach has a cœcum, but the pyloric cœca are wanting.

The Chromidæ generally inhabit the fresh waters of warm climates. One small species is caught in great quantities in the Mediterranean; and another, which inhabits the Nile, and attains a length of two feet, is regarded as one of the best fishes to be found in Egypt.

The *Pomacentridæ* resemble the Chromidæ in their general form, and, like these, are principally found in hot climates; but they are exclusively inhabitants of the sea. They have the ctenoid scales and interrupted lateral line of the fishes of the preceding family, but are destitute of the fleshy lips, and of the appendages to the spiny rays of the dorsal fin. The inferior pharyngeal bones, also, are completely fused together; the fourth branchial arch has two rows of unequal laminæ; and the preoperculum is usually toothed, or even armed with spines. The stomach is furnished with a cœcum, and the intestines with pyloric appendages.

In the third family, the *Labridæ*, the fleshy lips again make their appearance, and the body is clothed with large cycloid scales; the lateral line is uninterrupted. The mouth is protrusible, and armed with formidable teeth in the jaws; the palate is unarmed, but the lower pharyngeal bones, which, as in the preceding family, are completely coalescent, are furnished with broad grinders. In some species (such as those of the genus *Scarus*), the jaws are formed into a sort of beak, which is covered with a modification of the teeth, giving them in some cases a very close resemblance to the beak of a parrot, whence some of these fishes are denominated Parrot-fishes. The fourth branchial arch has only a single series of laminæ, the stomach is simple, and the pyloric cœca are wanting.

The Labridæ are distributed in the seas of most parts of the world; they are gene-

rally of moderate size, of a stout and somewhat compressed form, and in many instances adorned with the most beautiful colours. Some of our British species scarcely yield in this respect to those of the tropical seas. They are known by different names on different parts of the coast —Wrasse, Rock-fish, &c. In some places they are called *Old Wives*, and the French give them a similar name. The species here figured, the *Labrus maculatus*, or Ballan Wrasse (Fig. 25), is a common British species, which attains a length of about eighteen inches, and varies greatly in its colour; being sometimes blue or green, spotted with orange, sometimes entirely of different shades of the latter colour. One of the most beautiful species is the Blue-striped Urasse (*L. variegatus*), of which the general colour is orange, becoming reddish on the back, yellow on the belly; the sides are striped with blue; the anterior portion of the dorsal fin is blue, edged with orange, and the hinder part orange, with blue spots. The remaining fins are orange, with blue edges.

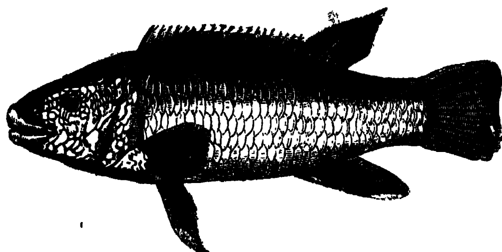


Fig. 25.—*Labrus maculatus.*

The Labridæ generally keep amongst rocks, where they conceal themselves under the seaweed, and feed upon the crustaceous animals which they find in abundance in such situations. Most of them bite very readily, and are often captured by baits intended for other and more valuable fish; for the Wrasses, although so splendid in their external appearance, are regarded as but indifferent food. When caught, they are generally cut up and used as bait for other fishes. In the British Seas they spawn in April, and the young are often to be seen in profusion about the rocks during the summer. Some of the Mediterranean species are said to spawn twice in the year.

## Sub-order IV.—Acanthoptera.

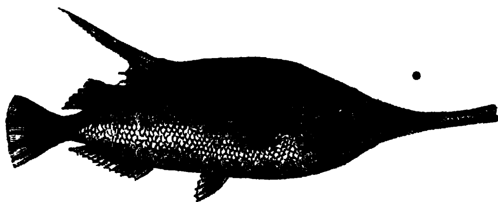
**General Characters.**—This sub-order includes those of the Acanthopterygii, or Spiny-finned Fishes of Cuvier, which have the inferior pharyngeal bones distinctly separated. The rays of the first dorsal fin are always spinous, and the first rays of the remaining fins (with the exception of the caudal) are often of the same structure. The membranous portion of the first dorsal fin is sometimes wholly or partially deficient, when the spinous rays stand freely on the back, and constitute formidable defensive weapons. The ventral fins are almost always situated in the neighbourhood of the pectorals on the breast or throat; the bones forming the upper jaw are free and moveable, and the air-bladder, when present, is completely closed.

**Divisions.**—The number of fishes belonging to this sub-order, which may be regarded as the most typical of the class, is exceedingly great, greater perhaps than in any other of the equivalent groups; the families, also, as might be expected, are rather numerous, and present a considerable diversity of structure.

The first of these is rendered remarkable by the form assumed by the heads of the

fishes composing it,—the bones of the face and some of those of the head being drawn out into a longish tube, at the extremity of which is the opening of the mouth, which is very small, and composed of the usual maxillary and mandibular bones (Fig. 26). Hence the names of Sea Snipes, Trumpet Fishes, Bellows Fishes, &c., applied to these animals; and the scientific name of the family, *Aulostomidæ*, also refers to the same peculiarity of structure. The skin is sometimes naked, and sometimes clothed with small ctenoid scales, and in one genus (*Amphisyle*) the back is covered with large scaly plates.

In one genus the spiny fin-rays are entirely wanting, and the ventral fins are always placed upon the belly, indicating a certain approach to the Physostoma. The first dorsal fin is sometimes represented only by a series of small spines running along the back of the animal, and the second soft dorsal is placed far back, close to the tail; in other cases (Fig. 26), the first ray of the dorsal is produced into a long spine, which is generally placed on the back of the animal, but in the genus *Amphisyle*, already referred to, this spine forms the actual hinder extremity of the animal, projecting backwards in the same line as the axis of the body, and having the second dorsal and the true caudal fin in front of it, on the lower surface of the fish.


Fig. 26.—Sea Snipe (*Centriscus scolopax*).

These fishes are, for the most part, inhabitants of the seas of warm climates. The species figured above, the *Centriscus scolopax*, is found in the Mediterranean, the most northern locality regularly inhabited by any fish of this family, although a single specimen has been cast ashore on the coast of Cornwall. It is about four or five inches long, reddish on the back and sides, and silvery on the belly, with more or less of a golden tinge. In others, principally inhabiting the eastern seas, the body is elongated and cylindrical; one of these, the *Fistularia tabacaria*, attains a length of three feet.

The second family of spiny-finned fishes, the *Triglidæ*, or *Cataphracta*, is characterized by having the series of dermal bones which occupy the lower portion of the orbit (the *infra-orbitals*) greatly expanded and coalescent, forming bony plates which cover the cheeks and articulate with the preoperculum. The head is also usually more or less armed with spines and other angular prominences, or furnished with membranous appendages, which not unfrequently give these fishes a most singular appearance. The fins are generally greatly developed; the dorsal is sometimes separated into two distinct fins, and sometimes forms a single continuous fin, of which the anterior portion is spinous, the posterior soft. In some cases, as in the common Sticklebacks (*Gasterosteus*), the membranous portion of the first or spinous dorsal is wanting, and the rays form a more or less numerous series of acute spines on the back of the fish. The pectoral fins are always of large size, sometimes remarkably developed, as in the genus *Dactyloptera* (Fig. 27), where they attain such a length as to enable the animal to support itself in the air for a short time. Hence these fishes are commonly known

as *flying fish*; one species is common in the Mediterranean. In the common Gurnards (*Trigla*), which we so often see in the fishmongers' shops, the pectoral fins are also of considerable size, and the three first rays of each are destitute of membrane, and separated from the rest of the fin, so as to form cirri or tentacles. The ventral fins are usually of small or moderate size, and placed on the breast beneath the pectorals; in the Sticklebacks, they are replaced by a single strong spine on each side, which constitutes a powerful offensive weapon for these pugnacious little creatures.

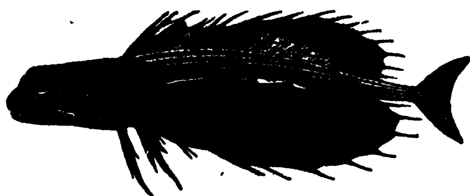


Fig. 27.—Dactyloptera Mediterranea.

The skin is rarely naked, usually covered with small ctenoid scales. In the Sticklebacks, and some other genera, the scales are replaced by bony plates (Fig. 28). The majority of these fishes are inhabitants of the sea; only a few species of the genera *Gasterosteus*, or Sticklebacks, and *Cottus*, or Bull-heads, being found in fresh water. The best known species are the Gurnards (*Triglæ*), of which several species are taken round the British coasts. Of these the commonest is the Sapphirine Gurnard (*T. hirundo*), which may often be seen in the shops with its broad pectoral fins skewered in a most ludicrous manner over its large angular head. It is the largest of the British species, occasionally measuring two feet in length, and its flesh is considered to be very good. The Gurnards generally inhabit deep water, from which they are taken by the trawl net; they may also be caught by line fishing. The Bull-heads (*Cottus*), of which several species inhabit the European seas, and one of which is found commonly in our fresh waters, are remarkable for the large size of their heads, which are frequently armed with spines in a most formidable manner. A nearly allied species, the *Aspidophorus europæus* (Fig. 28), is completely covered with bony plates. The Sea Scorpions (*Scorpænæ*) and some allied genera, perhaps present the most singular appearance of any fishes, their heads being not only armed with spines and angular projections of the most remarkable form, but also frequently furnished with curious membranous lobes and filaments.

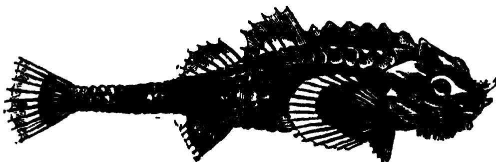


Fig. 28.—The armed Bull-head (*Aspidophorus europæus*).

But the most interesting species of this family, as regards their habits, are the Sticklebacks, of which several are found abundantly in our fresh waters. They are small fishes, measuring from two to three inches in length. The sides are more or less covered with bony plates; and those parts of the skin which are not thus protected, are quite free from scales. These little creatures present almost the only known instance amongst fishes in which the parents take any further care of their offspring than that of depositing their ova in a suitable place, the young fry being usually left to shift for themselves as soon as they

are excluded. The Stickleback, on the contrary, seems to approach the birds in the attention which it pays to the protection of its young from danger. About the time of oviposition, the male takes possession of some particular spot in the pond which he inhabits, and this he defends with the greatest pertinacity, attacking all intruders on his domain with great fury, and endeavouring to wound them with the ventral spines. According to an observer quoted by Mr. Yarrell, he even sometimes succeeds in ripping up and destroying his opponent by means of these formidable weapons. The object of all this exertion soon becomes apparent; the fish begins to collect small fragments of vegetable matter, with which he forms a sort of nest. In this the female deposits her spawn, and it seems not improbable that during the operation of nest-building, the male fish endues the materials of his nest with the milt, as he is observed to pass frequently over the nest whilst in progress, apparently exuding a glutinous matter at each time of his so doing. Be this as it may, after the deposition of the ova, the male still keeps watch over his treasure, attacking all intruders with the same ferocity as before. Nor does his care cease when the young fry are evolved: he still continues to watch, and carries back any incautious straggler to the security of the nest. It is very singular that in every case it is the male that takes upon himself all the duties of nidification.*

The *Gasterosteus spinachia*, or Fifteen-spined Stickleback, a marine species which is not uncommon round our coasts, also forms a nest for its ova. The common Stickleback (*G. trachurus*), which has three spines on the back, and bony plates along the whole length of its sides, is found both in salt and fresh water. It is found in the sluggish streams and pools of the Lincolnshire fens in such vast quantities that it is occasionally employed as manure; and Pennant tells us that at Spalding, in that county, a man has been known to make as much as four shillings a day by selling Sticklebacks at a halfpenny a bushel.

The vast family of the Perches, or *Percidæ*, of which the common Perch may be taken as the type, is distinguished from the preceding by the freedom and small size of the infra-orbital bones in the fishes of which it is composed. The mouth is large, and the jaws, vomer, and palatine bones are armed with numerous small teeth, amongst which a few longer fangs are often present. The head is generally free from those angles and spines which give so many of the Cataphracta such a remarkable appearance, but the edges of the opercula and preopercula are usually toothed or even armed with spines; and if either of these bones be smooth at the margin the other is always toothed. The fins are well-developed; the dorsal fin is sometimes continuous (Fig. 29), sometimes divided into two parts; the ventrals are placed either on the breast or throat. The skin is clothed

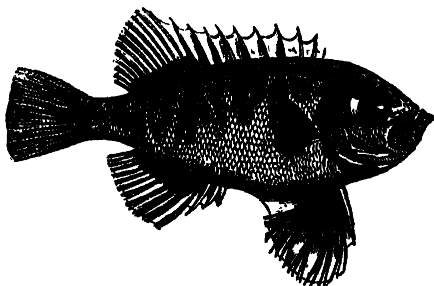


Fig. 29.—Priacanthus japonicus.

* Very interesting accounts of the habits of the Stickleback during the breeding season, by Mr. Hancock and Mr. Warrington, will be found in "The Annals of Natural History," for October, 1852.

with ctenoid scales, the free surface of which is often beset with spiny processes. The branchiostegous rays are generally seven in number, sometimes more, but very rarely fewer.

The Percidæ are generally handsome fishes, often of considerable size and of beautiful colours. They abound in the seas of all parts of the world; and some species also, like the common Perch, are inhabitants of fresh water. The Perch (*Perca fluviatilis*, Figs. 11 and 22), which is the best known species of the family, is a very common denizen of almost every piece of clear fresh water. It is one of the best and handsomest of our fresh-water fishes. Its body is broad and compressed; the back has two dorsal fins, of which the anterior is supported upon stiff, sharp, spinous rays, which are said to serve as a defence even against the voracity of the Pike. The colour of the upper part of the body is greenish-brown, gradually passing to a golden yellowish-white on the belly; and the sides are adorned with from five to seven broad blackish bands; the dorsal and pectoral fins are brownish, and the ventral, anal, and caudal fins of a bright vermilion colour, which adds greatly to the liveliness of the fish's appearance. The Perch does not usually attain a large size, one of three or four pounds being considered a heavy fish; but a few instances of the capture of Perch twice this weight are on record, and Pennant mentions his having heard of a specimen, taken in the Serpentine, which weighed nine pounds. As the Perch bites freely, it is much sought after, especially by young anglers; and its flesh when taken is exceedingly good. Like the other species of the family, it is an exceedingly voracious fish, feeding indiscriminately upon any animal it can master, especially worms, insects, and small fishes. It is very tenacious of life, and will live for a considerable time out of the water. Mr. Yarrell states that in Catholic countries it is a common practice to bring the Perch to market alive, when, if not sold, they are returned to the ponds from which they were taken, to remain there until they are again wanted. Another fresh water species, the Sander (*Lucioperca sandra*), is common in Germany and the east of Europe. It is of a much more elongated form than the Perch, and attains a length of three or four feet; its flesh is considered excellent. A small species, nearly resembling the Perch in its general form, but having a continuous dorsal fin, is found in almost all the rivers of this country. This is the Ruffe (*Acerina vulgaris*); it rarely exceeds seven or eight inches in length, but its flesh is said to be very good.

Of the marine species very few are found in the British seas. The best known of these is the Basse (*Labrax lupus*), sometimes called the Sea Perch, which is found in considerable abundance round the southern coasts of our islands. It is usually from twelve to eighteen inches in length, but it is said occasionally to attain a much larger size. It is highly esteemed as an article of food. The Bass is exceedingly abundant in the Mediterranean, which is also inhabited by several other fishes of this family, some of them of large size.

We have separated from the Percidæ of Professor Müller the three following small families, as they appear to possess characters of sufficient value to justify such a proceeding.

The *Trachinidæ*, known in England as the *Weevers*, have two dorsal fins, of which the anterior is small but very strongly spinous; the ventral fins are situated in front of the pectorals on the throat; and instead of the rough ctenoid scales of the true Perches, the skin is covered with smooth cycloid scales. They are generally of an elongated form, with a broad head, on which the eyes are placed in such a manner as to look more or less upwards; in fact one genus has received the name of *Uranoscopus*, or Star-

gazer, from this circumstance. The second dorsal and anal fins are of nearly equal length, and occupy the greater part of the upper and lower surfaces of the body; the anus is thrown very far forwards. They have no air-bladder.

The strong spines with which the first dorsal fin and the opercula of these fishes are armed, enable them to inflict severe wounds upon those who handle them incautiously, and the effects of these wounds are so exceedingly painful, that there is a general belief amongst the fishermen that the species possess some venomous property. Two species are found in the British seas, the largest of which, the *Trachinus draco*, attains a length of twelve or eighteen inches. They appear to prefer deep water, and are very voracious in their habits. They live for a considerable time after being taken out of the water; and the flesh, at least that of the larger species, is highly esteemed.

A second small family, which is still included with the Percidæ by many authors, is composed of the Mullets (*Mullidæ*). They agree with the Perches in the position of their fins; but the opercular bones are entirely unarmed, and the branchiostegal membrane has only four rays. The scales are very large, and readily fall off; their hinder margins have scarcely any indications of the ctenoid structure. In most of the species the under jaw is furnished with cirri.

A well-known example of this group is the common Red Mullet (*Mullus surmulletus*), which is often taken in considerable plenty off the British coasts. The Mullet, although comparatively a small fish, is in high esteem; its flesh is white, firm, well-flavoured, and easy of digestion. Amongst the epicures of ancient Rome its reputation stood very high, and large sums were often paid by them for particularly fine fish. Thus a Mullet of six pounds is said to have produced a sum equal to £48 sterling, and a larger one as much as £64; whilst no less than £240 were given for three large Mullets, which were procured on the same occasion, for a repast of more than usual magnificence—(*Yarrell*). The Romans also kept Mullets in glass vases; but these appear to have been specimens of the smaller species, the *Mullus barbatus* (Fig. 14), which is of a still more beautiful colour than the common Mullet of our shops. Both species are abundant in the Mediterranean, and occur also in the British seas, although here the *M. barbatus* is far from being common.

The third of these groups, which were referred by Müller and Cuvier to the Perches, is the family of *Sphyrænidæ*, of which a few species are found in the Mediterranean, although the greater number live in the seas of tropical climates. The fishes of this family are of an elongated form, somewhat resembling the Pikes (*Esocidæ*), with which Linnæus placed those species with which he was acquainted; in the form of the head and jaws, and the formidable nature of the teeth, they also somewhat remind one of those soft-finned fishes. They are, however, furnished with two dorsal fins, separated by a considerable interval, of which the anterior is strongly spinous; and the air-bladder is completely closed. They differ from the Percidæ in having the ventral fins placed on the belly, at a considerable distance behind the pectorals, the margins of the opercula and preopercula perfectly smooth, and the scales, which cover not only the body but also the sides of the head, of the description called cycloid.

The Sphyrænidæ are all exceedingly predaceous fishes, and some of them attain a considerable size. The best known species, the *Sphyræna vulgaris*, which appears to be tolerably common in the Mediterranean, often measures as much as three feet in length, and is a handsome, silvery fish, with a bronzed or bluish back. It is said that the fluid

called "essence d'orient," used in the manufacture of artificial pearls, is prepared from the scales of this fish, together with the minute silvery particles of its air-bladder. A species inhabiting the seas of tropical America, the *S. Barracuda*, grows to a much larger size, and is almost as much dreaded as the shark by the inhabitants of those countries. Its flesh is said to be exceedingly good, and not unlike that of the pike; it is eaten both salted and fresh. At certain times, however, it is found to be unwholesome; and this quality is said to be derived from its feeding at those periods upon the fruit of the manchineel-tree, although this appears to be exceedingly improbable. The symptoms produced by eating it when thus out of condition are sickness, nausea, and violent pains in the joints; the latter are said to have lasted for five-and-twenty years, accompanied by a loss of hair and of the nails. It is asserted that the poisonous individuals may be recognised by the bitterness of the liver, and by the flowing of a white fluid from them when cut; when salted, they are said to lose their injurious properties.

The *Sciænidæ* are also nearly allied to the Perches, with which they agree in the arrangement of their fins, and in having the opercula and preopercula dentated; but the vomer and palatine bones, which in the Percidæ are always armed with teeth, are toothless in these fishes. Some of the bones of the head are inflated and cavernous, giving a more or less convex appearance to the forehead; the mouth is large, and the jaws are usually armed with powerful fangs, interspersed amongst the smaller teeth. The body is always covered with ctenoid scales, which, as in the Sphyrænidæ, frequently extend over the head. The air-bladder is of very singular construction; it is completely closed, and furnished with numerous cœcal appendages, which are often branched, and sometimes surround it in such a manner as to give it the appearance of a fringed bag. This peculiar form of the air-bladder is very striking in the Maigre (*Sciæna aquila*), as figured by Cuvier and Valenciennes, and by Mr. Yarrell.

The Sciændiœ are large and powerful rapacious fishes. The species just referred to is common in the Mediterranean, and occurs occasionally on our own coasts, where specimens upwards of five feet in length have been taken. In the Mediterranean, it often grows to six feet. Its flesh is considered pretty good, and was in great repute with the Roman epicures.

The Maigres swim in small shoals, uttering a peculiar grunting noise, which is said to be audible even when the fishes are at a considerable depth. When taken, their strength often renders their struggles very inconvenient in the boats, as they are said to be capable of knocking over their captors. To avoid such a disagreeable interruption to their labours, the fishermen usually knock them on the head as soon as they are got into the boat. The bones of the ear in the Sciænidæ are usually larger than in most other fishes, and, in former days, extraordinary properties were attributed to them; they were said to prevent and cure the colic, and for this reason were often honoured with a gold setting, and suspended from the neck. It was necessary, however, that the *colic-stone*, as it was called, should have been presented to the wearer, otherwise it was of no efficacy. Numerous species of this family inhabit the seas of the warmer regions, and many of them furnish excellent food.

The *Sparidæ*, in their general form, and in their toothless palates, present a great similarity to the fishes of the preceding family; but the bones of their opercula are not toothed or spinous, and the forehead does not exhibit the inflated appearance characteristic of the *Sciænidæ*. The ctenoid structure of the scales is very indistinct in this

family; the scales, as in the preceding family, cover the sides of the head, but never extend over any portion of the fins. The body is usually broad and much compressed, with a single long dorsal fin, of which the anterior portion is supported upon strong spinous rays; the ventral fins are placed on the breast under the pectorals. The teeth are sometimes in the form of acute fangs, of which some are often of considerable size, whilst in other species they are broad and rounded, constituting a powerful grinding apparatus, with which the fishes thus provided crush the hard shells of the Mollusca, on which they principally feed.

The Sparidæ are all inhabitants of the sea, and most of them are found in warm climates, although the Mediterranean possesses several species; and a few are not unknown on our own coasts. They are divisible into two groups, which, in fact, were regarded as distinct families by Cuvier. In one of these groups (the *Mænides*), the mouth is protrusible, the pedicles of the intermaxillary bones being very long, so as to give the upper jaw a considerable power of motion. Some species are very abundant in the Mediterranean; but their flesh is very little esteemed. A West Indian species (*Gerres rhombeus*) is said occasionally to find its way to the coast of Cornwall, accompanying pieces of wood covered with barnacles, which are conveyed across the ocean by the currents.

In the other group (the true *Sparides*), the upper jaw is firmly attached to the head, and not protrusible; of these, several species are occasionally taken off the British coasts. Some of them attain a length of upwards of two feet; and several are highly prized as food in the countries bordering the Mediterranean, where they occur in great abundance. They appear to be voracious fishes, feeding on Mollusca, Crustacea, and small fishes; but some of them vary this diet by devouring sea-weeds, which they tear from the rocks.

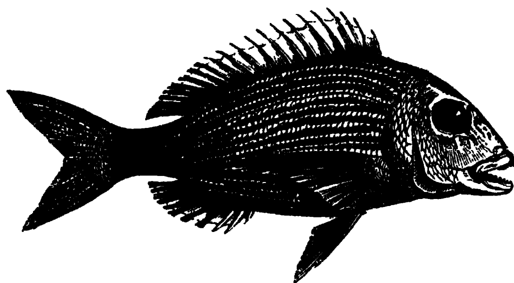


Fig. 30.—Pagrus vulgaris.

The great family of the *Chætodontidæ* is distinguished from the preceding groups by the exceedingly compressed form of the body, and by the singular manner in which the soft parts of the perpendicular fins are clothed with scales, often to such an extent that the boundary between the body and fin is quite undiscoverable (Fig. 31). The fishes of this family are generally of a discoid form, like many of the common flat fishes, but the eyes are placed on each side of the head, both sides of the body are similarly coloured, and the fishes swim upright in the water. The mouth is usually small, and furnished with bristle-like teeth; in a few species it is larger, and armed with cutting teeth, or fangs. The whole body, including the sides of the head, and the base of the median fins, are covered with ctenoid scales; the dorsal fin is single, with a few, usually short, spinous rays at its anterior part; the first soft rays of the dorsal and anal fins are sometimes produced into long filaments, or the fins themselves are very long, and pointed anteriorly, gradually decreasing in depth towards the hinder part of

the body, so that the whole fish assumes the form of a crescent, with the tail projecting from the centre of the concavity. The ventral fins are placed under the pectorals.

The Chætodontidæ are generally of small or moderate size, and most of them are inhabitants of the tropical seas. They are remarkable for the exceeding magnificent colours with which they are generally adorned, and which are rendered still more pleasing to the eye by the broad black bands which, in most cases, traverse the body from the dorsal to the ventral margin. One of these bands generally passes down the region of the eye.

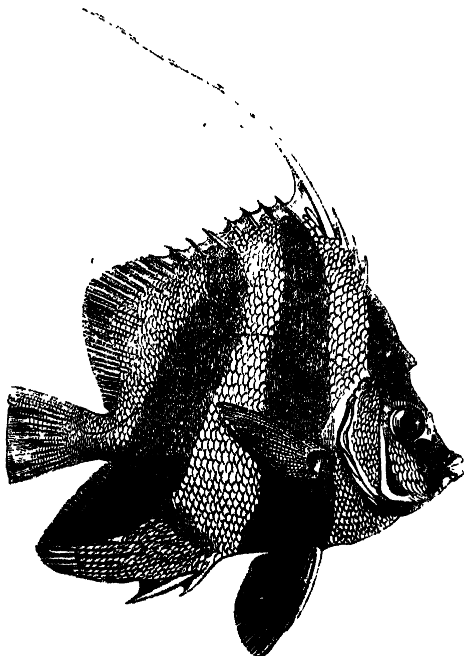


Fig. 31.—Heniochus monoceros.

The flesh of these fishes is said to be exceedingly delicate and well flavoured. Only a single species (the *Brama Raii*) inhabits the British seas, where it is by no means common, although in the Mediterranean it occurs in great abundance. It is said occasionally to measure two feet six inches in length; but the largest specimen seen by Mr. Yarrell did not exceed sixteen inches. Its flesh is highly esteemed. A singular species, the *Chelmon rostratus*, inhabiting the Chinese seas, has the jaws very much prolonged, forming a sort of beak, but so inclosed in the skin that only a small opening is left at its extremity for the mouth. This fish is said to exhibit a very curious instinct; it projects a drop of water from its mouth at any insect that it perceives within reach of such a missile, so as to bring it down into the water, where, of course, it falls an easy prey to its dexterous assailant. The Chinese keep these fishes in basins, and amuse themselves by watching their efforts to bring down a fly suspended over them by a thread. A Javanese species, the *Toxotes jaculator*, which has a wide mouth, with the lower jaw considerably prolonged, exhibits the same singular instinct; it is said to throw the water to a height of three or four feet, and rarely to miss its aim.

The family *Teuthidæ*, includes a small number of fishes, which are all inhabitants of the seas of hot climates, and which are remarkable for having the sides of the tail armed either with several sharp prickles, or with a large curved spine (Fig. 32). They are of a broad compressed form, with a single dorsal fin, in front of which there is often a free spine. The body is covered with ctenoid scales, which, however, do not extend over any part of the fins; and the jaws are furnished with a single series of cutting teeth.

The Teuthidæ are herbivorous fishes, feeding upon sea-weeds. The species with spinous tails, if incautiously handled, inflict severe wounds upon their captors; and the common West Indian species (*Acanthurus chirurgus*) has received the name of the *surgeon* from this circumstance.

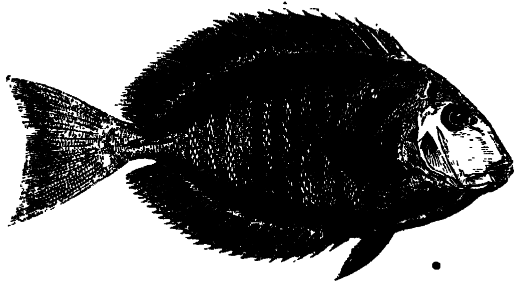


Fig. 32.—Acanthurus phlebotomus.

The next four families were included by Cuvier in a single group. They are all composed of active fishes, with powerful fins and smooth bodies, usually covered with small scales, which are often concealed in the skin; the opercula are unarmed. The pyloric cœca are numerous.

In the great family of the *Scomberidæ*, or Mackerels, many of which are of such great importance as food, the skin is sometimes quite naked, sometimes more or less clothed with cycloid scales, and the tail, which is slender and furnished with a powerful, usually forked fin, is almost always marked with scaly ridges. The fishes of this family have sometimes one, sometimes two dorsal fins; in some cases the spinous rays of the first dorsal are very short and destitute of membrane; in others the fin is well-developed, and the rays are furnished with long filamentous appendages (Fig. 33). The second dorsal and the anal also exhibit a considerable diversity of structure; the spinous portion of the anal fin is frequently separated from the soft part; and the latter, both in the anal and second dorsal, may either form an entire fin, or give rise to a series of small fins, running along the upper and lower surfaces of the tail, a structure which is readily seen in the common Mackerel. The teeth are generally confined to the jaws; they are almost always acute, and often of large size.

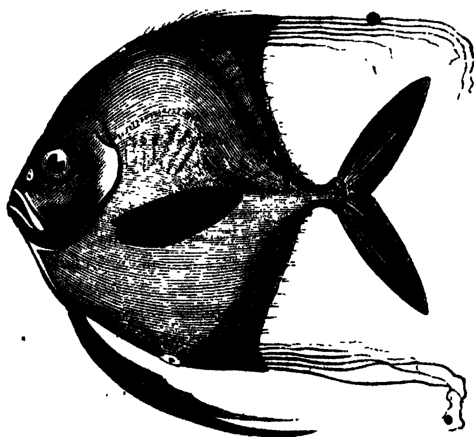


Fig. 33.—Blepharis.

The fishes of this family are all marine, and usually predaceous in their habits. In the form of their bodies they present two distinct types which might perhaps be regarded as sufficient for their division into two families. In one, the *Zenides*, the body is short, broad and compressed, presenting a good deal of resemblance in form to the Chætodontidæ, with which these fishes also agree in the considerable development of the perpendicular fins, which are often furnished with

filamentous processes (Fig. 33). The mouth is usually protrusible, and the teeth small and weak.

Of this group the commonest species is the Doree, or John Dory (*Zeus Faber*, Fig. 34), which is taken abundantly on our southern coasts, and which was regarded by the epicure Quin as such a delicacy, that it was worth the trouble of a journey from Bath to Plymouth, and back again, in order to eat Doree boiled in sea-water. The origin of the English name of this fish has frequently exercised the ingenuity of zoological etymologists; but the most rational derivation appears to be from the French *dorée*, or *jaune dorée*, which refers to the golden yellow colour of the fish when fresh. Roman Catholic legends point to it as the fish from which St. Peter took the tribute-money; the black marks on its sides being ascribed to the pressure of the Apostle's fingers. Hence it is known in several countries of Europe as *St. Peter's Fish*, although the Haddock, which also exhibits a blackish mark on each side of the body, is considered by many to dispute its title to this honour. The Doree sometimes attains a weight of ten or twelve pounds; but the ordinary weight of those brought to the London market is between four and six.

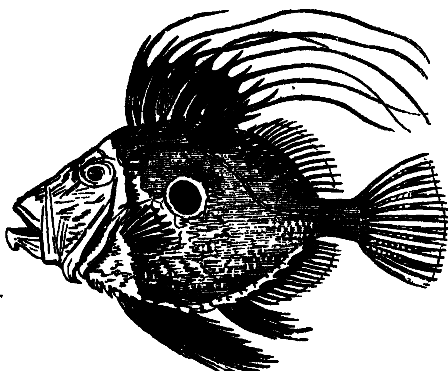


Fig. 34.—The Doree (*Zeus Faber*).

Two other species of this section of the family are occasionally taken in the British seas, although they are apparently rare. One of these, the Opah, or King-fish (*Lampris guttatus*), appears to be distributed over nearly the whole globe, as, according to Mr. Yarrell, it has not only been taken in the European seas, but is also said to occur on the west coast of Africa, and appears to be well known both in China and Japan. In the latter empire the Opah is sacred to the Japanese Neptune. It is a magnificent fish; the back and sides are of a fine green, with purple and gold reflections, fading into yellowish green on the belly, and covered with numerous round whitish spots; the fins are of a fine vermilion colour. Mr. Yarrell tells that a person, looking at a specimen of this fish, observed "that it looked like one of Neptune's lords dressed for a court day."

The second division of the family, the *Scomberides*, includes a great number of exceedingly valuable fishes, which present more or less resemblance to the common Mackerel. The body, instead of being compressed, is elongated and spindle-shaped, or occasionally almost cylindrical; the mouth is large, not protrusible, and frequently armed with large teeth. The type of this section is the common Mackerel (*Scomber Scomber*), a fish which is too well known to need any description. The Mackerels usually spawn during the months of May and June; and it is when approaching the shores in vast shoals for this purpose that they are principally taken. The most common mode in which the fishing is carried on is by means of long nets, called *drift nets*, which often extend for nearly a mile in length, descending into the water to a depth of about twenty feet. These nets are let down into the water at nightfall, and

left in position all night, suspended to a stout rope, which is supported at one extremity by a large buoy, and at the other attached to the fishing-boat. The meshes of the net are just large enough to allow the fish to pass through as far as the pectoral fins; so that when they have advanced thus far they are held suspended in the net, without the power of escaping, either by retracing their course or pressing the thick part of their bodies through the obstacle. In the morning the nets are hauled in, and the fish detached from them, and in this manner vast quantities of Mackerel are taken. The Mackerel is also captured by surrounding the shoals with a large deep net, called a *seine*, which is afterwards closed at the bottom, or hauled to the shore; and a considerable number are taken with hook and line. It is a voracious fish, feeding principally upon small fishes and the fry of larger species. The ordinary size of those brought to market is from fourteen to sixteen inches, with a weight of from one-and-a-half to two pounds; but they are said occasionally to attain a length of twenty inches.

The Tunny (*Thynnus vulgaris*), a fish belonging to this family, which is very abundant in the Mediterranean, grows nearly to twenty feet in length, and weighs sometimes as much as ten hundredweights. Like the Mackerel, this large fish approaches the shores in large shoals for the purpose of spawning, when it is captured by means of a large net, called a mandrague. This is composed of nets arranged in a funnel-like form, so that the fish, entering the wide mouth, are gradually led up to a narrow prison, when they are destroyed by spears and harpoons. Professor Vogt, who has given a most animated description of the Tunny fishery, states that these nets extend a quarter of a mile, and cost as much as thirty thousand francs. The flesh of the Tunny is highly prized by the inhabitants of the countries bordering the Mediterranean, where its capture has been an important object since the most remote antiquity. Several allied species are also found in that sea, amongst which the most celebrated is the Bonito (*Thynnus pelamys*), which rivals the Dorado in its perpetual chase of the Flying-fish.

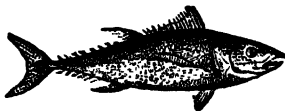


Fig. 35.—Tunny (*Thynnus vulgaris*).

One of the most remarkable fishes of this family is the Pilot-fish (*Naucrates ductor*), which receives its name from its habit of accompanying ships for weeks together; the ancients even asserted that it pointed out the proper course to the mariner when he was at a loss how to proceed, leaving him when he had arrived in sight of the desired haven. It appears probable, however, that the Pilot-fish only attends the voyager for the sake of the numerous pieces of food which are constantly being thrown overboard; and a community of feeling in this respect may, perhaps, account for the frequent association of the Pilot-fish and the Shark. It is, however, a general opinion amongst navigators that the Pilot-fish really attends upon the Shark as a guide; and an instance has been related in which two of them led a Shark to a baited hook that had been thrown out for him. Another observer, however, quoted by Dr. Hamilton Smith, in "Griffith's Animal Kingdom," states that he repeatedly saw a Shark, which was inclined to swallow a bait put out for him, pre-

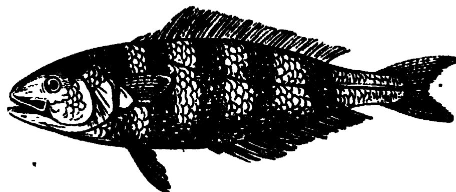


Fig. 36.—Pilot Fish (*Naucrates ductor*).

vented from doing so by one or other of four Pilot-fishes which accompanied him; and that when at length the Shark had swallowed the tempting morsel and was being hauled out of the water, one of his diminutive friends clung to his side for some little time. Colonel Hamilton Smith also states that he had witnessed a similar circumstance. The Pilot-fish attains a length of about a foot. It is somewhat of the form of the Mackerel, of a silvery gray colour, bluish on the back, and adorned with five dark blue bands, which go round the whole body. Its flesh is said to be very good.

Nearly allied to the Mackerels are the Sword-fishes, *Xiphiidæ*, which are rendered remarkable by the prolongation of the upper jaw into a long, spear-like weapon. They are also characterized by the structure of the branchiæ, the laminæ of each branchial arch being united so as to form a band-like organ, in which the separation of the laminæ is only indicated by superficial marks. This structure occurs in no other bony fishes. In the form of the body they resemble the Mackerels; the spinous dorsal fin commences close to the neck, where it is high and sickle-shaped, and runs thence nearly to the tail, where it is followed by a small soft fin; the anal fin exhibits a very similar construction, although it is much shorter. The ventral fins are wanting, or represented only by a pair of spinous rays, situated on the throat; the caudal is deeply forked, and the sides of the tail have large ridges.

The common Sword-fish (*Xiphias gladius*) is found not uncommonly in the Mediterranean, and occurs sometimes in our own seas. It is a large fish, attaining a length of fifteen, or even twenty feet, and is most predaceous in its habits, employing its long bony spear for the destruction of the larger fishes. Its activity and strength are very great; and it has been known to strike at ships passing through the water, and to bury its weapon in their timbers. Cuvier states that a parasitic crustacean buries itself in the flesh of the Sword-fish, and torments it to such an extent that it will sometimes rush upon the shore; the same cause of irritation may, perhaps, have something to do with its suicidal attacks upon such a very unequal antagonist as a ship.

The common Sword-fish is the only European species of this family; but the seas of tropical climates contain several others. Their flesh is said to be exceedingly good, especially when young.

In the *Coryphænidæ* the body is much compressed, with a broad dorsal fin running along the whole of the back; all the rays of this fin are almost equally flexible, although those of the anterior portion are not articulated. The ventral fins are frequently wanting; when present they are usually very small and placed under the pectorals, although sometimes situated on the throat. The abdominal cavity is small, so that the anal opening is placed far forwards, and the anal fin usually occupies a considerable portion of the ventral surface, sometimes extending forwards to the level of the pectorals. The dorsal and anal fins are generally very high; and in one genus (*Pteraclis*) they attain such a development as to make the lateral surface of the whole fish at least three times as great as that of the body. The tail fin also is very large, and usually deeply forked. The mouth is of moderate size, and armed with acute teeth.

The Coryphænidæ are all inhabitants of the salt water, and generally occur only in the seas of warm climates. The only European sea in which they are found is the Mediterranean, which possesses several species. Amongst these the best known is the Dorado (*Coryphæna hippurus*), sometimes called the Dolphin, a fish adorned with the most beautiful metallic tints, and which is also remarkable for the swiftness of its course, and for the continual war of destruction which it wages with the Flying-fish.

It attains a length of about five feet; the head is large, and the body tapers gradually from this to the tail. The back is bluish, the belly yellow, and the whole surface spotted with a darker blue. When in the water it presents a splendid golden lustre which, however, rapidly vanishes when it is taken out of its native element.

The fourth and last of the families, formed by modern authors at the expense of the Cuvierian Scomberoides, is that of the *Notacanthidæ*, in which the body is much elongated, and more or less Eel-like in its form, and has its hinder extremity usually surrounded by the same continuous fin that is characteristic of the Eels. The spinous portion of the dorsal fin is destitute of membrane, so that the rays form a series of spines running along the back; the second or soft dorsal is frequently wanting altogether. A further point of resemblance to the Eels is presented by the pectoral fins, which are attached to the spinal column at some distance behind the head; the ventral fins are sometimes wanting, and when present are situated on the abdomen. The whole surface is covered with small cycloid scales, and the front of the upper jaw is usually produced into a sort of beak. Most of the species of this family occur in the tropical regions; but one, the *Notacanthus nasus*, is found in the Arctic Ocean. Some of them live in fresh water.

In the exceedingly elongated form of their bodies, the fishes of the next family, the *Cepolidæ*, or Ribbon-fishes, present a considerable resemblance to the Notacanthidæ, but their bodies are much compressed, so as to acquire a ribbon-like form. The dorsal fin, which always commences close to or upon the head, is completely furnished with membrane; and the caudal, when present, is usually quite distinct from the other perpendicular fins. The position of the caudal fin in some of these fishes is very peculiar; instead of being placed at the extremity of the body as in most fishes, it is set on at a right angle, forming a fan-like organ extending upwards from the extremity of the tail. The ventral fins are sometimes altogether deficient; when present they are placed under the pectorals, and are sometimes of small, sometimes of large size, and occasionally represented by one or more long spines. The body is covered with very small scales.

These singular fishes are all inhabitants of the sea; several species have been taken on our own coasts, although they are of rare occurrence. Several of them attain a considerable length; the one here figured, *Gymnetrus Banksii* (Fig. 37), having been found as much as twelve feet long. With this extraordinary length its greatest thickness was two inches and three quarters. It is of a beautiful silvery colour, with a few blackish streaks and spots. Some of the species, although rarely met with, appear to have a very wide geographical distribution; the *Lepidopus argyreus*, or Scabbard-fish, is found on the English coasts and at the Cape of Good Hope; and the *Trichiurus lepturus* inhabits the seas of both America and the Old World. Scarcely anything is known of the habits of the fishes of this family.

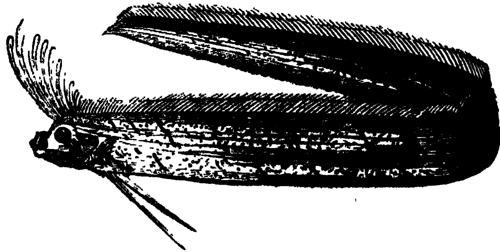


Fig. 37.—Gymnetrus Banksii.

The family *Mugilidæ*, of which the Grey Mullet is a typical example, includes only a few fishes, with a more or less cylindrical or spindle-shaped body, covered with large scales, which, although in reality ctenoid in their structure, lose their denticulations so easily that they often appear to be cycloid. The head, which is somewhat flattened above, is covered with similar scales, or with polygonal plates; the mouth is rather small, and furnished with excessively fine teeth, which are sometimes almost imperceptible. In their appearance, these fishes present a good deal of resemblance to some of the more elongated Cyprinidæ, but are easily distinguishable from these by the distinct, spinous, first dorsal fin, which is rarely supported upon more than four rays, and is separated from the second dorsal by a considerable interval. The ventral fins are placed on the abdomen, a little behind the pectorals. The pharyngeal bones are very large; the stomach is furnished with a sort of fleshy gizzard, and the intestine with a few pyloric cœca.

The Mugilidæ generally inhabit salt water, keeping by preference about the mouths of rivers, which they usually ascend and descend with the ebb and flow of the tide. Our common Grey Mullet (*Mugil capito*) is regarded as a very delicate fish, and the county of Sussex is especially celebrated for it. It is exceedingly active in the water, and often escapes the fishermen by leaping over the headrope of the net; when one of the prisoners has taken this course, the others are sure to follow, unless the net be raised sufficiently to prevent them. Two other species of *Mugil* are found upon the British coasts, but they appear to be rare; the Mediterranean possesses five species.

The Sand-smelt (*Atherina presbyter*) a small fish which is tolerably abundant along the south coast of our island, also belongs to this family. It resembles the Grey Mullet in the habit of ascending the mouths of rivers with the tide. The Sand-smelt is about five or six inches in length, and is considered to have some resemblance to the Smelt in its flavour. It is a favourite fish with visitors to the southern watering places, but seldom reaches the London market.

Nearly allied to the Mugilidæ is the singular family of the *Anabatidæ*, the remarkable habits attributed to one member of which has obtained for it the name of the Climbing Perch. The fishes of this family are very variable in form—sometimes broad and flat, sometimes elongated and cylindrical; they have a single dorsal fin, of which the anterior portion is usually strongly spinous, but in some species the rays of this part of the fin, although undivided, are very flexible. The anal fin is also single, with a spinous anterior portion. The whole surface is covered with scales, which in the soft-finned species are truly cycloid, whilst those of the spiny forms are ctenoid. The ventral fins are placed under the pectorals; one of the rays is frequently much elongated, and in some species the ventral fin is represented by a single long filament.

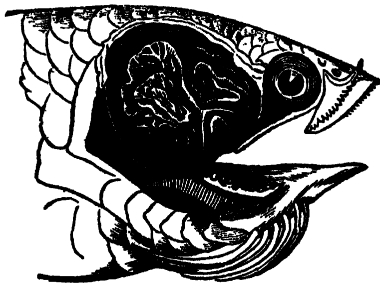


Fig. 38.—Head of Anabas scandens, with the operculum removed.

The most remarkable character presented by these fishes, however, consists in the structure of the superior pharyngeal bones (Fig. 38), which are dilated into voluminous folded laminæ, inclosed in a large cavity of the base of the skull, and forming numerous cells, in which a supply of water

may be carried, for the purpose of moistening the gills, when the creature, as its habit is, quits the water for a time.

This peculiar structure attains its greatest development in the *Anabas scandens*, or Climbing Perch of India (Fig. 39), which is by this means enabled to live out of the water for as long a period as six days. They frequently quit the ponds or streams which they inhabit, and wander for a considerable distance over the land—a circumstance which has led the inhabitants of the countries frequented by them to suppose that these fishes fell from the skies. They are even said to climb trees; and Daldorff states that he once took a specimen, at a height of five feet from the ground, on the stem of a palm-tree,—but this habit has been denied by some other naturalists. Daldorff's statement, however, receives some support from the Tamul name of the fish—*Paneiri*, or the *Climber of Trees*. This and some other species of the family are commonly exhibited by the jugglers of India and China, to which countries the fishes of this family are almost entirely confined; their flesh is exceedingly good, and one species, the *Gourami* (*Osphromenus olfax*), which grows to the size of the Turbot, is considered even to excel that highly-prized European fish. The Gourami is a native of China; but has been naturalized in the Mauritius, and even in Cayenne. The great tenacity of life possessed by these fishes enables the fishermen to bring them to market alive; and the larger species are often cut up alive to suit the convenience of the smaller consumers.

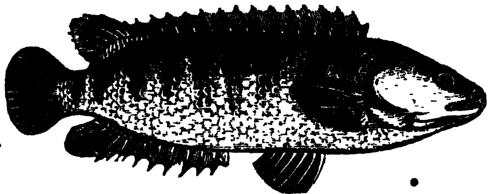


Fig. 39.—Climbing Perch (*Anabas Scandens*).

The *Gobiidæ* are usually distinguishable at the first glance by having the ventral fins, which are situated on the breast, united into a funnel-shaped disc. These fins are sometimes distinctly separated, or united only at their bases; but even in these cases they are usually capable of being formed into a funnel at the pleasure of the animal. The pectoral fins are large, and the entire rays of the dorsal and anal fins soft and flexible. The skin is sometimes naked, sometimes clothed with large, finely ctenoid scales; the edges of the opercula are unarmed, and the opercular aperture small, so that these fishes are enabled to live for some time out of the water. The stomach and intestines are both destitute of cœca.

Some of the fishes of this family produce living young, but the majority appear to be oviparous. The male of a species of *Gobius*, inhabiting the Mediterranean, has been observed to make a nest amongst the seaweeds, with the roots of the *Zostera*, or Grass-wrack; in this he awaits the females, which soon come to deposit their spawn; this is fecundated by the male, and he then remains as a guard over the precious deposit, which he defends with the greatest courage. This habit of the *Gobius* was probably known to the ancients, as Aristotle mentions a fish, called *phycis*, which he says is the only fish that constructs a nest: we have already seen, however, that it is certainly equalled in this respect by our common Sticklebacks (page 41).

The Gobiidæ are, for the most part, small fishes, which keep close to the shore, usually amongst rocks; they often attach themselves by means of their disc-like ventral fins to the lower surface of stones and other objects. Some species are also abundant in tidal rivers.

One of the largest and most singular species is the Lump-fish (*Cyclopterus lumpus*), which inhabits the northern European seas, and may often be seen hanging up in the shops of the London fishmongers. It is also called the Lump-sucker, and is the Cock-paddle of the Scotch. The Lump-fish sometimes weighs as much as seven pounds, and is of a thick massive form; but its flesh is very soft and insipid. It is of a purplish black colour, variegated with red and brown, and the belly is crimson. The back and sides have rows of tubercles, and the appearance of the fish is extremely grotesque. The sucker, formed of the ventral fins, is of a somewhat oval form, and of great size and power. So firmly does it adhere by means of this organ that, according to Pennant, on putting a freshly-caught specimen into a pail containing several gallons of water, it fixed itself so firmly to the bottom that the whole pail, with its contents, could be lifted by taking hold of the tail of the fish. It is said to feed upon Medusæ and other gelatinous marine animals, and in its turn affords a favourite repast for the Seals, which, however, reject the skin.

A still more remarkable and celebrated fish belonging to this family is the Remora, or Sucking-fish (*Echeneis*, Fig. 40), of which a few species are found in the seas of various parts of the world. In this genus the ventral fins are only united at the base, and do not appear to be applicable to the attachment of the animal to submarine bodies; but to compensate for this, the upper surface of the head is furnished with a singular disc, formed of transverse, cartilaginous, denticulated plates, by means of which the Remora attaches itself to rocks, ships, and even to the bodies of large fishes.

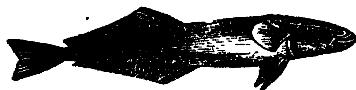


Fig. 40.—Sucking Fish (*Echeneis remora*)

The habit which this fish has of fixing itself to the bottoms of ships, gave rise, in ancient times, to the opinion that it could thus instantaneously arrest the course of a ship in full sail; and the names still applied to it in several countries refer to this fable, which is related in the most circumstantial manner, and with the utmost good faith, by several ancient authors. Thus, amongst other marvellous tales, we are told that at the battle of Actium, Antony's ship was held motionless by a Remora, notwithstanding the exertions of several hundred sailors; and on another occasion we are informed that Caligula, when on a voyage, was arrested by one of these fishes, which attached itself to the rudder, and manifested such an invincible determination that the emperor should not proceed on his voyage, that the efforts of four hundred able seamen were of no avail, until one of them, more knowing than his fellows, ascertained the cause of this disagreeable occurrence, and, by detaching the obstinate Remora, set the ship free to pursue her course. The common Remora is about a foot long, and somewhat of the form of the Herring. It occurs commonly in the Mediterranean, and is also found in the ocean, and occasionally on the British coasts. Some of the other species are larger and more elongated.

The Dragonets (*Callionymus*), of which two species are found on our coasts, are arranged amongst the Gobiidæ, although they appear to possess characters which might entitle them to form the types of a distinct family. Their branchial apertures are very small, and placed at the upper part of the opercula, close to the back; and their ventral fins are very large and distant. The eyes are placed on the top of the head, looking upwards; the skin is smooth and scaleless, and the first dorsal fin has bristle-like rays, of which the first is sometimes exceedingly elongated. They are

handsome fishes, of moderate size, often adorned with brilliant colours, and their flesh is said to be very good.

Nearly allied to the preceding are the *Blenniidæ*, which were, in fact, placed in the same family with the Gobies by Cuvier. They are distinguished, however, by the structure of the ventral fins, which are placed on the fore part of the breast, or on the throat, and consist only of a few, usually two, rays. In the Sea-wolf (*Anarrhicas lupus* Fig. 41), the ventral fins are entirely wanting. They agree with the Gobiidæ in the structure of the intestinal canal, and in the absence of the air-bladder; the skin is either naked or furnished with very small concealed scales, and is covered with a great quantity of mucous matter; from the latter circumstance the name of the typical genus *Blennius* (Gr. *blennos*, mucus) is derived. The dorsal fin is very long, usually extending throughout the whole length of the back; the entire rays of this and of all the other fins are flexible, as in the preceding family. The pectoral fins also are very large. The mouth is usually armed with acute fangs, which, in the Sea-wolf, acquire most formidable dimensions, and are accompanied by an inner series of blunt molars, which serve to crush the shells of the molluscous animals upon which this creature usually feeds. The abdominal cavity is short, and the anal fin consequently of considerable length. The head is frequently furnished with tentacular filaments, which are sometimes singularly branched (Fig. 42).



Fig. 41.—Sea-wolf (*Anarrhicas lupus*).

Of the British species, the Shanny (*Blennius pholis*) is remarkable for the habit exhibited by the larger specimens, of creeping out of the water, with the aid of their pectoral fins, as the tide recedes, and hiding themselves in holes amongst the rocks, where they remain until, on the return of the tide, the water again covers them and sets them at liberty. They place themselves singly in these caves, with their heads outwards; and if any danger shows itself at the mouth of their retreat, they immediately retire backwards to its more sheltered recesses. This fish has even been known to survive a confinement of thirty hours in a dry box; but it is soon killed by being put into fresh water.

Many of these fishes produce living young; and, in general, the outlet of the male generative organs is situated in a small prominence near the anal opening, which gives considerable support to the opinion that a genuine copulation must take place between these fishes.

Of the British Blennies, one species, the *Zoarcus viviparus*, exhibits this peculiarity of bringing forth its young alive; and they are said to be perfectly able to take care of themselves from the moment of their exclusion. The young appear to be of different sizes, in proportion to the size of the females producing them. Thus, Mr. Yarrell mentions that a specimen of fifteen inches long, which was brought to the Edinburgh fish-market, contained several dozens of young, which were still alive, and measured from four to five inches long; whilst the young of another female, seven inches in length, were only about an inch and a-half long.

The Blennies are generally of small size, and of little or no value. They swim together in small shoals amongst the rocks of the sea shore, and are constantly to be found in the small rock pools left by the retiring tide. They are exceedingly active,

and difficult to catch, even when confined within a small space, dashing and leaping about with the greatest rapidity, and concealing themselves under the sea-weeds which fringe their pool. Like the Gobiidæ, they are able to live for a considerable time out of the water; and one species, the *Salarias scandens* of Ehrenberg, which inhabits the Indian Ocean and the Red Sea, is able to climb and leap about the rocks of the shore. It is so exceedingly active in this somewhat anomalous position that it has been taken by some observers for a small Lizard; and as it can take leaps of four or five feet, it is by no means easy to catch.

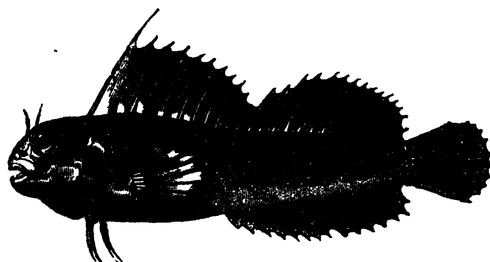


Fig. 42.—Ocellated Blenny (*Blennius ocellaris*).

One of the largest and most formidable fishes of our seas is the Sea-wolf (*Anarrhicas lupus*, Fig. 41), which belongs to this family, and the dentition of which has already been referred to. In the British seas, this fish attains a length of six or seven feet, and in more northern and colder latitudes it is said to grow still larger. The back of this formidable fish is of a brownish-gray or olive-brown colour, with transverse black or brown stripes, which extend more or less over the whitish belly. Its common food consists of crustaceous and molluscous animals, for crushing which its powerful apparatus of teeth is especially adapted, and the strength of its jaws is exceedingly great. When captured, it defends itself vigorously, attacking the fishermen with the greatest ferocity, and often inflicting severe wounds upon those who are not very careful in their approaches; this ferocity, however, is the means of shortening the captive's life, for the fishermen, knowing its habits, generally contrive to knock it on the head before it has an opportunity of doing any mischief. Its appearance is completely in accordance with its nature; for few fishes look more savage than the Sea-wolf. Its flesh, however, is said to be exceedingly good; and as it bears salting well, it is of no small importance to the inhabitants of Iceland, where it is found in great abundance. The skin is converted into a sort of shagreen, which is much used for making bags and pouches; and Cuvier states, that the Icelanders employ its liver in place of soap.

The *Lophiidæ*, forming the last family of the spiny-finned fishes, present a good deal of resemblance to the Gobiidæ, and especially to the *Callionymi* and their allies; they are particularly distinguished by having the carpal bones very long, forming a sort of arm, at the extremity of which the pectoral fins are supported. The ventral fins are placed in front of these, on the flattened lower surface of the body; and the pectoral fins thus form, as it were, a pair of hinder legs, upon which many of the creatures are able to hop about upon the sea-beach in a very curious manner. Most of these fishes have a large head, and a short, stout body, terminated by a slender tail. They are covered with a naked skin, which is usually roughened with warts and tubercles of different kinds. The branchial aperture, which is placed behind the pectoral fins, is very small, whilst the branchial cavity itself is of large size; and, as is

usual in fishes which exhibit this conformation, the Lophiidæ are able to endure a tolerably prolonged absence from the water.

The best known of these fishes is the *Lophius piscatorius* (Fig. 43), commonly known under the names of Angler, Fishing Frog, and Sea Devil. It is perhaps one of the ugliest of all fishes; its head is of enormous size, forming nearly half the entire body, and is cleft in front by a most formidable transverse mouth, armed with numerous pointed teeth. The head is much depressed, and the eyes are placed upon the top of it, rather close together. The body is very short, and terminated posteriorly by the pectoral fins, behind which it runs off into a gradually tapering tail, bearing two dorsal fins, and the caudal and anal fins.

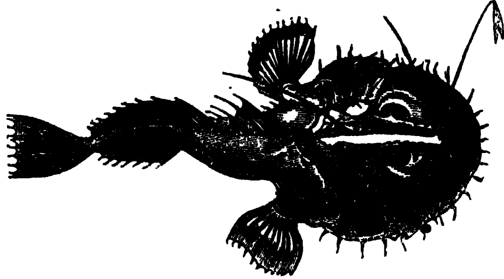


Fig. 43.—Fishing Frog (*Lophius piscatorius*).

The Fishing Frog is a sluggish fish, and as its voracious appearance by no means belies its character, it might be supposed that it would have some difficulty in gratifying the enormous appetite which must apparently be associated with such a tremendous mouth. It is said, however, that the fish possesses a stratagem by which to satisfy the cravings of its maw, without the necessity of subjecting its unwieldy person to any very violent exertion. On the upper surface of the front of the head are two long moveable bony filaments, the foremost of which is dilated at its tip, which has a silvery lustre. Lying close to the ground, the fish disturbs the sand or mud, so as to obscure the water around it, justly thinking, no doubt, that its appearance is not sufficiently amiable to inspire much confidence in the weaker inhabitants of the deep; it then elevates the filamentous appendages just described, and waves them to and fro in the water, when the small fishes, which are soon attracted by the hope that this silvery object is something to eat, become instead the prey of their artful foe. This is said to be the ordinary mode of procuring its food followed by this fish, but it certainly at times seeks its prey by other methods. Thus Mr. Yarrell quotes a case in which one of these fishes seized a Cod which had just been hooked by a fisherman, and allowed himself to be drawn up to the surface, where he was only compelled to quit his hold by a severe blow on the head; and on another occasion a Fishing Frog seized a Conger Eel that had just been hooked, when the latter wriggled himself through the narrow branchial aperture of his second captor, and in this manner both fishes were drawn up together.

The *Lophius piscatorius* is a large fish, sometimes attaining a length of no less than five feet. The most common size, however, is about three feet, and specimens of this size are not unfrequently taken at various parts of the coast. In itself, the fish is of no value, but many of the fish found in its capacious stomach are generally quite uninjured, sometimes even alive; and the fishermen frequently make a little money by exhibiting the fish itself to sea-side visitors, generally accompanying their exhibition with a most doleful lamentation upon the ravages committed by their not very prepossessing captive.

## Sub-order V.—Lophobranchia.

**General Characters.**—In all the groups of bony fishes which we have hitherto had under consideration, the gills are formed of comb-like series of laminæ; but in the Lophobranchia, these organs are arranged in little tufts, disposed in pairs along the branchial arches, a conformation which is not exhibited by any other bony fishes. The opercula are very large, but are confined throughout by a membrane which only leaves a very small aperture for the exit of water, and the branchiostegous rays are entirely wanting. The body is very elongated in its form, and covered with bony plates, which are usually of considerable comparative size, so that the body becomes more or less angular. The fins are usually very imperfectly developed; the pectorals are small, the ventrals usually altogether absent, and the caudal and anal fins are also often wanting. The bones of the face are much prolonged, forming a sort of snout or proboscis, at the extremity of which the oral aperture is situated, a structure very similar to that which we have seen in the family Fistularidæ (page 39), in the preceding sub-order.

This sub-order includes only a single family, the *Syngnathidæ*, composed of small fishes of very singular appearance. The best known form is the *Hippocampus* or Sea-horse (Fig. 44), so called from the remarkable resemblance which they present to that mammal when the elongated head is bent at about a right angle to the axis of the body. One species is found in the British seas; but specimens of tropical species are often brought home by sailors, and may commonly be seen in the shops of dealers in curiosities. They possess no caudal fin, and make use of the long tapering tail to support themselves, by twisting it round the stems of sea-weeds and other objects. In this position they present a very curious appearance, wonderfully justifying the popular comparison with the horse.

The true *Syngnathi* are of a still more elongated form than the *Hippocampi*, and have the head in the same direction as the axis of the body. They are commonly known as Pipe-fish, and some species are tolerably abundant on some parts of our coast; the largest British species is said by some authors to attain a length of three feet. The habits of all the species appear to be very similar; they swim about slowly amongst the sea-weeds, feeding upon minute Crustacea, worms, Mollusca, &c.

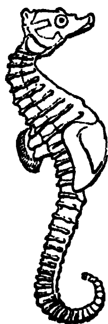


Fig. 44.—Sea-horse (*Hippocampus*.)

The most singular part of the history of these creatures, however, is their mode of reproduction. Individuals are found furnished with a curious pouch or cavity at the base of the tail, which is either completely closed, with the exception of a small opening, or concealed by a pair of membranous folds. In the course of the summer this is found filled with eggs; and at a later period, when the fry are hatched, it appears that they continue for a time to seek shelter from danger in this singular cavity. The attachment of the *Syngnathi* to their young has been noticed by several authors; and Mr. Yarrell says, that he has been assured by fishermen that if the young be shaken out of the pouch into the water, close to the boat, they do not swim away; but when the parent fish is held in the water, in a favourable position, the young again enter the pouch. The most remarkable circumstance, however, connected with this is that the pouch-bearer is the male fish, and that the female is quite destitute of any such organ, so

that the ova must actually be deposited by the latter in the abdominal receptacle of her mate.

Mr. Walcott's observations upon a British species, the *Syngnathus acus*, as quoted by Mr. Yarrell, are as follows:—"The male differs from the female in the belly from the vent to the tail fin, being much broader, and in having, for about two-thirds of its length, two soft flaps, which fold together, and form a false belly (or pouch). They breed in the summer; the females casting their roe into the false belly of the male. This I have asserted from having examined many, and having constantly found, early in the summer, roe in those without a false belly, but never any in those with; and, on opening them later in the summer, there has been no roe in those which I have termed the female, but only in the false belly of the male." Mr. Yarrell also states, that he has ascertained the correctness of these statements by the dissection of specimens, and found that the individuals with the ventral pouch were actually furnished with the usual internal organs of the male sex, whilst those which had no pouch possessed ovaries crowded in the usual manner with eggs.

The mode in which the ova are introduced into the ventral pouch of the male is still unknown; but it is remarkable that amongst fishes, wherever any unusual care is taken of the eggs and young, this duty always devolves upon the male; whereas, amongst other classes, it appears to be a general rule that the care of the young is the special business of the mother; although, in many cases, the male undoubtedly shares in the labours of his partner. Thus the males of many birds assist in collecting materials and in the construction of the nest, and, in some instances, even take a share in the work of incubation; but we know of only one instance amongst birds in which the eggs and young are dependent exclusively upon paternal care.

### Sub-order VI.—Plectognatha.

**General Characters.**—In this, the last group of the Teleostia, we meet, to a certain extent, with a combination of the characters of this and the following orders. The bones of the head are perfectly ossified; but the remainder of the skeleton, and especially the vertebral column, often remains in a state very similar to that which prevails in many of the Ganoid and Cartilaginous fishes. The union of the bones of the head also is much closer than in the other fishes of the present order; and the principal character of the group consists in the firm attachment of the bones of the upper jaw and palate to those of the cranium. The principal part of the upper jaw is made up of the inter-maxillary bones, which constitute the entire margin of that part of the mouth, and these are firmly fixed to, or rather amalgamated with, the cranial and maxillary bones. The bones of the palate, also, are immoveably attached by a suture to those of the cranium. The head is large; the mouth small; and the opercula are so covered by skin and muscles, that only a small aperture is left for the exit of the water employed in respiration. The body is usually short and stout, and covered with a thick skin, which is sometimes roughened by scattered points, like those in the skin of the Sharks, and sometimes more or less covered with bony plates. The fins are small and soft; the ventrals usually entirely deficient. The intestinal canal is short and destitute of pyloric cœca, and most of them possess a large air-bladder.

**Divisions.**—The Plectognatha form only two families. The *Sclerodermata* have the head more or less produced into a snout in front of the eyes; at the extremity

of this is the mouth, armed with a series of distinct teeth, which are received into sockets of the jaws, and bear some resemblance to the front teeth in man. The body is covered with bony plates, which in some cases, as in the Trunk-fish (*Ostracion*, Fig. 45), are of large size and regular shape, covering the whole surface of the body with a suit of inflexible bony armour. The tail is inclosed in a sort of bony tube; and this and the pectoral fins are the only moveable parts of the fish; the vertebræ even are usually immoveable. The dorsal fin is single, small, and entirely composed of soft rays. They are generally of small size, and are found only in the seas of warm climates.

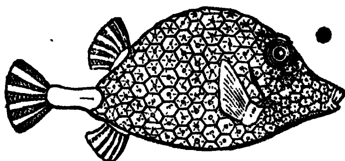


Fig. 45.—Trunk-fish (*Ostracion*).

In the fishes of the genus *Balistes* (Figs. 46 and 47) and their allies, on the other hand, the dermal skeleton takes the form of regular scales or grains, leaving the skin a certain amount of flexibility; the ventral fins are often represented by a pair of powerful denticulated spines, and the back bears two dorsal fins, of which the anterior is formed of strong spinous rays, the first of which is usually very large, and denticulated in front. This first dorsal fin is sometimes reduced to a single strong spine; it is supported upon a bone attached to the head, and can be retracted within a groove formed in the latter. These fishes are generally of rather small size; they inhabit the tropical seas, and are often adorned with the most brilliant colours. One species occurs on the British coasts. They are but indifferent food, and are said to become poisonous at certain seasons from feeding upon the coral-polypes; this, however, is probably a mistake, as Cuvier states, that in all specimens opened by him he found nothing but sea-weeds.

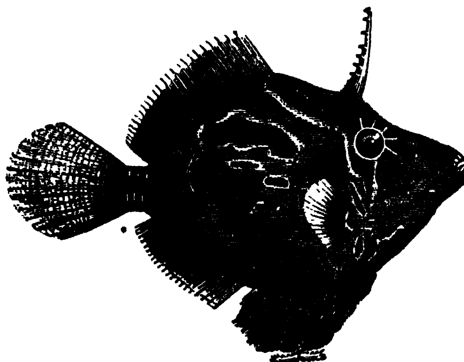


Fig. 46.—Balistes geographicus.

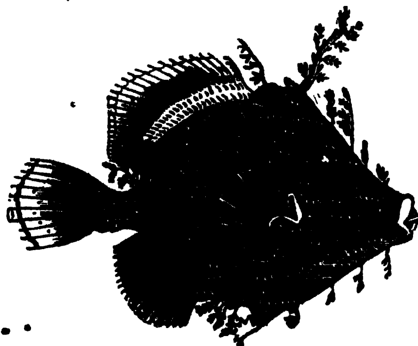


Fig. 47.—Balistes penicilligerus.

The second family, the *Gymnodonta*, is distinguished from the preceding by the structure of the mouth, which, instead of teeth, has the surfaces of the jaws covered with a plate of an ivory-like substance. They feed upon sea-weeds, and also upon Crustacea and Mollusca, in breaking up the shelly coverings of which these solid jaws are of great

service to them. The skin is thick and leathery, usually beset with spines; and the branchial aperture is reduced by it to a very small size.

Like those of the preceding family, the majority of these fishes are found only in the seas of warm climates, very few occurring in the waters of Europe. Some of them, belonging to the genera *Diodon* and *Tetraodon*, have a large air-bladder, and possess the singular power of inflating the body with air, so as to swell it up into a more or less globular form. This inflation is effected by the passage of air into a large sac, which opens into the œsophagus, and extends over the whole of the belly beneath the skin. The air, according to Mr. Darwin's observations, is swallowed, and then forced into the sac, where it is retained by a muscular contraction. This sac was formerly described as a crop, or first stomach. When thus distended, the great quantity of air collected in the ventral region causes the fish to float with its belly upwards at the surface of the water, in a most helpless position, although it appears to have some little power of directing its course by the agency of the pectoral fins. The distension of the skin also causes the spines with which it is covered to erect themselves in a most formidable manner, affording an efficient protection against the attacks of ordinary enemies. Mr. Darwin states that a species observed by him, on the coast of Brazil, was able to bite most severely; and that it could eject water from its mouth to some distance, at the same time making a curious noise by the movement of its jaws. A singular phenomenon presented by this fish was, "that it emitted from the skin of its belly, when handled, a most beautiful carmine-red secretion, which stained ivory and paper in so curious a manner, that the tint is retained with all its brightness to the present day." These fishes, some of which are well known as Sea Porcupines, are of moderate size, some of them measuring above two feet in length. They are, however, of little value; their flesh being very indifferent, if not absolutely unwholesome. One species has been taken on the coast of Cornwall; it was first described by Pennant, who considered it identical with the *Tetraodon lævigatus* of Linnæus—a species found in Carolina. Mr. Yarrell considers it to be distinct from this, and has described it under the name of *T. Pennantii*. It attains a length of more than a foot and a-half, and the diameter of the inflated belly, in a specimen of this size, is about a foot. A species found in the Nile, the *T. lineatus*, which is said to possess electrical properties, is often deposited on the banks of that river by its periodical inundations; on finding themselves hopelessly deserted by the water, they always swell up their ventral sac, and become dried in this inflated condition, when they are collected by the children and used as balls.

The largest species of the family, and indeed of the whole sub-order, are the *Orthagorisci*, which have a soft skeleton and a short, thick body, destitute of tail; the air-bladder and the ventral sac of the preceding fishes are entirely absent, and the fishes possess no power of inflating their bodies. The appearance of these fishes is very peculiar; they look like the anterior portion of some very large fish, cut off through the dorsal and anal fins, and then closed behind and furnished with a broad caudal fin. Of this curious group two species are found in the British seas, although they appear to be rather rare in the waters surrounding our coasts. One of these, the Short Sun-fish, or the Sun-fish, *par excellence* (*Orthagoriscus Mola*), is almost of a circular form, with long dorsal and anal fins projecting like handles from its hinder part, the space between these being occupied by a broad caudal fin. About the centre of the body, on each side, is a small pectoral fin, and in front of this, the orifice of the branchial cavity. The other British species, the *O. oblongus*, is of an oblong form; it has the fins in the

same position as the circular species. Both these fishes attain a large size; the Short Sun-fish, in particular, sometimes weighs three or four hundred pounds, and measures four or five feet in length. The flesh of the *Orthagorisci* is soft and very indifferent, and possesses a disagreeable odour; qualities which cause it to be very little esteemed. It is, however, fat, and yields a considerable quantity of oil. When alive these fishes have a silvery appearance, and at night they are said to be exceedingly phosphorescent; from which circumstance, coupled with their more or less rounded form, it is probable that the names of Sun-fish and Moon-fish, applied to them in different places, are derived.

## Order IV.—Ganoidea.

**General Characters.**—Of the remarkable fishes belonging to this order very few exist at present in our waters. But their fossil remains occur in abundance in almost all the fossiliferous strata of the earth, and, in some of the older formations, constitute almost the only indications of the existence of vertebrated animals upon our planet at the period of the deposition of these strata. It was, in fact, the abundance and variety of these fossil remains that first called the attention of naturalists to these fishes, and thus introduced a new and important element into ichthyological classification. Professor Agassiz, in his great work on the fossil fishes, found it necessary to adopt a different system from that generally in use amongst zoologists, as, in many instances, the organs upon which the latter relied for the characters of their groups, were absent or unrecognizable in the remains of the fishes of former ages. Under these circumstances he derived the leading characters for his general classification of Fishes from the form and structure of the scales, or dermal appendages (see page 14), these organs being generally well preserved in fossil specimens; and this has undoubtedly been of great service to the study of fossil Ichthyology. It cannot be denied, however, that, as is always the case where the structure of a single system of organs is adopted as the basis of a classification, the arrangement of Fishes proposed by Professor Agassiz is evidently artificial, and often violates the natural affinities of the animals, removing closely allied species to a distance from each other, and bringing others into close juxtaposition which have nothing in common but the general form of their scales.

This is abundantly evident from the study of the characters of the bony fishes, as already set forth, and it is equally true with regard to the Ganoidea of Agassiz, the establishment of which as a distinct order is the most important zoological point in the work of that eminent naturalist. In strict accordance with his principle of arrrangement, he includes under this order all the fishes which are either entirely or partially covered with bony plates—a character which is exhibited by many of the fishes already referred to amongst the Teleostia, such as the Lophobranchia, a considerable portion of the Plectognatha and Siluridæ, and many other fishes belonging to different groups of bony fishes. But a great many of the living representatives of the order Ganoidea, as originally circumscribed by Agassiz, were well known to be nearly allied to other species and groups in which the dermal skeleton never presented the ganoid structure, so that it became necessary either to violate these natural affinities by preserving the order in the form originally proposed by its founder, or to introduce into it new elements which did not exhibit the peculiarities by which it was characterized, and which, of course, would have entirely effaced the boundaries of the order. The perception of this difficulty induced Professor Müller to

investigate the structure of the living species of Ganoidea, and to compare it with that of the bony fishes on the one hand, and with that of the cartilaginous fishes on the other; and it appears from his researches that a portion of the Ganoidea of Agassiz present characters entitling them to rank as a distinct order, intermediate between the Teleostia and Selachia, but that a considerable number of the fishes originally referred to the order must occupy places amongst the Teleostia.

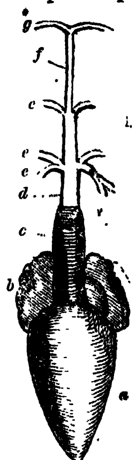
The character by which the Ganoidea were first distinguished from other fishes, was the nature of the dermal skeleton. This consists of smooth, bony plates, covered with a layer of enamel, which are sometimes distributed over the whole surface, sometimes confined to the region of the head, or arranged on the sides of the body with intervals of greater or less extent between them. They are frequently of a rhomboidal form, arranged edge to edge, in obliquely transverse rows, the plates forming each of these being attached to those of the next row by a distinct process. In other cases the covering of these fishes is formed of rounded scales, very similar, both in form and arrangement, to the horny scales of the Teleostia, but often very distinct from these in their structure. Like the scales of the Teleostia, these bony plates are formed in capsules of the skin, and the membrane of this capsule appears to extend in the form of a very thin pellicle over their surface. In a few species the skin is quite naked.

The skeleton of the Ganoid fishes presents a considerable diversity in its structure, and especially in the extent to which ossification takes place in it. Thus in some forms the centre of the vertebral column is reduced to a mere dorsal cord (*chorda dorsalis*), terminated by a cartilaginous skull, which is usually protected by external bony plates. The processes forming the arches for the passage of the spinal cord and aorta in these fishes are distinctly ossified. By degrees, however, the ossification extends further; the skull and vertebral column are seen to be composed of distinct bones; the bodies of the vertebræ exhibiting, in some cases, the same structure as in the Selachia, of a series of cartilaginous rings, inclosing a larger or smaller portion of the gelatinous matter of the original dorsal cord; whilst in others the vertebræ acquire the form exhibited by those of the Teleostia (see page 11), or even, as in the *Lepidosteus*, acquire a still higher development, the anterior surface of the body of each vertebra being furnished with a convex process, which fits into a cavity of the posterior surface of the preceding one. Thus the structure of the spinal column shows that the Ganoid fishes should occupy a position intermediate between the Teleostia and the Selachia, as the peculiarities of both these groups are reproduced in different members of the order; and the *Lepidosteus* even appears, in this respect, to approach the higher classes of Vertebrata, the Reptiles and Batrachia, in which its peculiar vertebral conformation is first met with. In the compound structure of the lower jaw also, the *Lepidosteus* presents a considerable resemblance to the Reptiles.

The structure of the fin-rays partakes of the same diversity as that of the skeleton. They are all, with the exception of the first rays in some of the fins, of a soft and flexible consistence; but in some cases they are entire, in others divided like the soft rays of most of the Teleostia. In many cases the edges of the caudal fin, and the anterior margins of the other fins, are covered by a series of small bony pieces, called *fulcra*, which are often so acutely pointed as to give the edge of the fin a strongly serrated appearance.

In number and position, the fins resemble those of many of the bony fishes. The pectorals are always present, as are the ventrals, with a few doubtful exceptions; the latter are always placed on the abdomen, and from this circumstance the living Ganoid

fishes were arranged by Cuvier and other naturalists with the abdominal Physostomata. The dorsal and anal fins present much the same differences of size and position as the corresponding organs in the Teleostia; but the arrangement of the caudal fin is frequently very different. In some cases the spinal column terminates at the middle of the caudal fin, which thus occupies the extremity of the body as in the fishes of the preceding order; whilst in others the extremity of the spine is continued in the form of a pointed process, beneath which the rays of the caudal fin are attached. Of these two forms of the caudal extremity, the former, which is denominated *homocercal*, is characteristic of the Teleostia, the latter, called *heterocercal*, of the Selachia; and the Ganoid fishes exhibit a tolerably gradual passage from the one to the other.



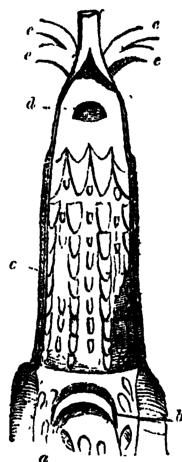




Fig. 48. Fig. 49.

Fig. 48.—Heart and arterial bulb of Lepidosteus.
*a*, ventricle; *b*, auricle; *c*, arterial bulb; *d*, branchial artery; *e e e*, branches leading to the branchiæ; *f*, continuation of the artery; *g*, branches leading to the opercular branchiæ.

Fig. 49.—The arterial bulb cut open.
*a*, ventricle; *b*, valve of the aperture leading from the auricle; *c*, muscular coat of the arterial bulb; *d*, opening for the posterior branch from which *e e* the branches leading to branchiæ rise.

In their internal anatomy, the Ganoidea present the same peculiar combination of the characters of the other two great orders of Fishes. Thus the arterial bulb, as that portion of the branchial artery which is situated immediately in front of the heart is called, instead of being formed merely by a thickening of the walls of the vessel, as in the bony fishes, is furnished with a distinct muscular coat (Figs. 48 and 49), by which it is enabled to act as a sort of supplementary heart, or elongated ventricle, in the propulsion of the blood through the branchial vessels; and to fit it more completely for the performance of this office, it is furnished internally with a great number of valves (Fig. 49), to prevent the return of the blood. This conformation is exhibited also by the Selachia, although the number of valves contained in the arterial bulb is much smaller in them than in the Ganoidea; but the Teleostia are only furnished with a single pair of valves at the aperture leading from the heart into the artery, and the latter is quite destitute of the muscular coat.

In the structure of the branchiæ the Ganoidea agree with the true bony fishes. They have all free, pectinated gills, contained in a cavity which is protected by an operculum, and closed beneath by a branchiostegal membrane, which is frequently furnished with branchiostegal rays. In addition to the regular branchiæ, there is frequently a supplementary branchial organ (the *opercular branchia*) attached to the interior of each operculum; and below this a false gill or *pseudobranchia*, which receives only arterialized blood. In some cases the top of the head is furnished with a pair of spiracles, a structure which occurs amongst the Selachia, but is never met with in the bony fishes. An air-bladder is always present; it communicates with the pharynx by a duct, as in the Physostomata.

The intestine is often furnished with a spiral valve, as in the Sharks and Rays. The arrangement of the optic nerves is also very different from that which prevails amongst the bony fishes. In the latter these nerves cross, so that each nerve runs to the eye of the side opposite to that from which it takes its rise. In the Ganoidea, on the contrary, the optic nerve runs to the eye of its own side, and the two nerves meet and unite at some little distance from their origin.

**Divisions.**—Professor Müller divides the living Ganoid fishes into two great groups, the *Holostea*, with a perfectly bony skeleton, and the *Chondrostea*, with the skeleton cartilaginous, and the centre of the vertebral column composed of a continuous soft *chorda*. The application of this rule to the fossil fishes of this order is, however, attended with considerable difficulties, as, according to Agassiz, species agreeing closely in their general characters with the former section, exhibit in the structure of their skeleton an approach to the second. Professor Vogt, deriving his classification from the forms of the dermal skeleton, divides the Ganoidea into three principal groups or sub-orders—the *Cyclifera*, in which the scales or plates covering the body are rounded, and lie over each other in the same manner as those of the true bony fishes; the *Rhombifera*, which have the body clothed with quadrangular bony plates; and the *Loricata*, which are either entirely naked, or have the head, and often the anterior part of the body, more or less covered with irregular plates of bone. The last of these groups corresponds with the Chondrostea of Professor Müller, and the two others may be regarded as equivalent to his Holostea; and as they appear to be more nearly related to each other than to the Chondrostea, and may very well be included in a single group, we shall retain Professor Müller's sections, especially as the principal characters upon which they are founded are exactly applicable to all the living species, the only examples to which we can satisfactorily appeal.

### Sub-order I.—Holostea.

**General Characters.**—The fishes belonging to this sub-order, both recent and fossil, are distinguished by having the entire surface covered either with scales or bony plates. In the *living* species, the skeleton acquires a bony consistence, and, in some cases, the ossification of the bodies of the vertebræ even proceeds to such an extent as to depart entirely from the ordinary piscine type, and to present no small resemblance to the structure prevailing in many Reptiles. In the form of the body and the structure of the head these fishes resemble those of the preceding order; the head in particular is never covered with a system of dermal bones.

**Divisions.**—The differences in the structure of the dermal covering exhibited by the fishes of this sub-order enable us to divide them readily into two principal groups. In one of these, the *Cyclifera* of Vogt, the body of the fish is covered with rounded overlying scales (Fig. 50 *b*), presenting a considerable resemblance, both in form and disposition, to those of the ordinary bony fishes. In some instances they are even of the same horny texture; and this is the case in the only living representatives of the group, the species of the genus *Amia* (Fig. 51), which, in

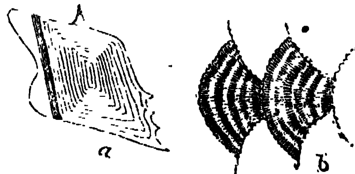


Fig. 50.—Scales of Ganoid Fishes. *a*, of Lepidotus; *b*, of Glyptolepis.

fact, have generally been regarded as true Teleostia. Others have similar horny scales, covered with a layer of enamel, whilst others again are furnished with scale-like bony plates.

The character of the dermal covering is not, however, the only point in which the Cyclifera depart somewhat from the normal Ganoid type and approach the true bony Fishes; the fins are entirely destitute of *fulcra* (see page 63), and in other respects exactly resemble those of the Teleostia; the arterial bulb (page 64, Figs. 48 and 49) has but a scanty muscular coat, and contains only two rows of small valves, and the spiral valve in the intestine becomes exceedingly small. None of these fishes have opercular branchiæ.

The nearest approach to the Teleostia is made by the family *Amiidæ*, the only family of this group of which we have living representatives (Fig. 51). They are clothed with small horny scales, usually covered with a layer of enamel, as are also the bones of the skull, over which a very thin skin is extended. They are nearly homocercal (the caudal fin occupying the whole posterior extremity of the body); but the spinal column turns up slightly at its extremity, so that the larger portion of the fin is situated below its termination, giving it, as it were, an indication of the heterocercal structure which prevails amongst many of the other members of the order. The species of the genus *Amia* inhabit the rivers of the warmer parts of America, where they feed on minute Crustacea. They are of small size, and but little valued as food.

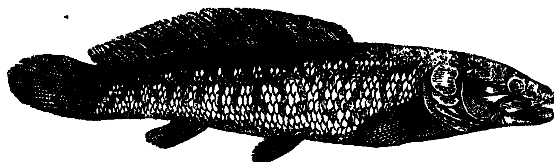


Fig. 51.—Amia marmorata.

In the fossil Cyclifera, the scales are of a bony consistence. They form two families, of which one, the *Cœlacanthidæ*, is characterized by having the scales rather small, and the perpendicular fins of extraordinary size, all placed upon the hinder extremity of the body, so as to present the appearance of a single enormous fin. There are always two dorsal and anal fins, and the caudal is generally symmetrical; although one genus (*Glyptolepis*, of which the scales have been figured in page 65) is heterocercal.

In the *Holoptychiidæ*, the scales are much larger and thicker than in the preceding family, and the whole surface, both of the bony scales and of the head, is covered with a layer of enamel, and often adorned with elegant raised patterns. They were heterocercal fishes, often of large size, and furnished with a formidable apparatus of conical teeth, which proves them to have been of a most predaceous disposition. The arrangement of the dentine and enamel in these teeth is exceedingly curious and complicated.

In the second section of the Holostea, the *Rhombifera* of Vogt, which may be regarded as the types of the Ganoid fishes, the bony scales are always of a more or less quadrangular form, usually rhomboidal (Fig. 50 *a*). They are arranged in oblique rows, and the edges are generally so bevelled that each scale slightly overlaps the one beneath it; whilst the plates in each row are usually connected with those in the next by means of peculiar processes. These plates are composed of true bony

matter, and covered with a beautiful layer of glassy enamel. The fins in the Rhombifera are always well developed, and generally furnished with fulcra; the ventral fins are abdominal in position, and the caudal extremity exhibits either the homocercal or the heterocercal character.

The fossil remains of fishes of this group are distributed through almost all the strata of the earth; but in our present world it has but few representatives belonging to two genera. The group may be divided into two sections, characterized by the presence or absence of fulcra on the fins, and each of these sections possesses one living genus.

Of the group in which the fulcra are deficient, the only living representatives belong to the family *Polypteridæ*. These fishes are distinguished by the peculiar structure of the dorsal fin, which is broken up into a number of separate spines, occupying nearly the whole length of the back, and each furnished with a soft fin attached to its posterior surface. The pectoral fins are broad, rounded, and fan-like, supported upon a sort of short, scaly arm; the ventrals are placed very far back: the anal fin is single, and the tail slightly heterocercal. The body is very elongated and cylindrical; the head depressed, and furnished with a pair of spiracles, which can be closed by a bony valve. The opercular branchiæ and pseudo-branchiæ are wanting, and the branchiostegal rays are replaced by a single large triangular bony plate.

The only known species of this family inhabit the African rivers. One (*Polypterus bichir*), which is found in the Nile, has sixteen dorsal fins, whilst another (*P. senegalus*), with twelve dorsal fins, inhabits the Senegal. The Nilotic species attains a length of about eighteen inches. It keeps in the muddy bottom of the river, and is only occasionally taken; it is regarded as an excellent fish for the table.

Nearly allied to the Polypteridæ are the *Dipteridæ*, a family of fossil fishes which have hitherto occurred only in the Old Red-sandstone. The Dipteridæ are decidedly heterocercal; the upper lobe of the caudal fin being much larger than the lower, and the tail running almost to its extremity. The upper surface of the tail is bordered, like the lower surface, with a rayed fin, but there are no traces of spines or fulcra either on this or on any of the other fins; the pectorals are of considerable size, the ventrals are small, and there are two large dorsal and anal fins, situated opposite to each other, near the hinder extremity of the body.

The *Acanthodidæ* were also heterocercal fishes, in which the upper surface of the tail was furnished with a small rayed fin, but quite destitute of spines or fulcra, whilst the remaining fins were all furnished with a single strong spinous ray. The dorsal and anal fins were single.

The fishes of this family were of small size, and covered with very small bony plates. They are found entirely in some of the oldest fossiliferous strata, the Old Red-sandstone and Carboniferous groups, and they are remarkable amongst the fishes of these early periods, from having the skeleton more distinctly ossified.

The family *Pycnodontidæ* is composed of homocercal fishes, of a broad, compressed form, which are distinguished from the other Ganoidea by the absence of ventral fins. They were small fishes, which probably derived their nourishment from molluscous animals; all the teeth of the jaws and palate, with the exception of the front teeth in the jaws, which resemble the human incisors, being broad and flat, so as to adapt them especially for crushing the hard shells of these animals. Their remains are found in several strata, but disappear after the Tertiary period.

Of the species in which the fins are furnished with fulcra, some are distinguished

by having a double row of those organs along the edge of the tail, whilst others have only a single row. The only living forms belong to the former series, and constitute, with several fossil genera, the family *Lepidosteidæ*. These are elongated Pike-like fishes (Fig. 52), which were formerly associated with the Esocidæ, and are generally known under the name of *bony pikes*. They are heterocercal, and both edges of the caudal fin are furnished with a double series of fulcra, as are also the anterior margins of the other fins. The jaws are usually produced into a long narrow snout, presenting a great resemblance to that of the Gangetic Crocodile, and armed with a double series of formidable conical teeth, the internal structure of which is very remarkable. The nostrils are situated quite at the extremity of the upper jaw, which is composed of several pieces bearing teeth; the lower jaw, in like manner, consists of several portions, presenting, in this respect, a close resemblance to that of many Reptiles. The vertebral column also presents a structure such as we meet with in no other fishes, the bodies of the vertebræ being regularly articulated together. The Lepidosteidæ are furnished with opercular branchiæ and pseudo-branchiæ; the branchiostegal membrane contains rays, and the air-bladder is of large size, and divided into numerous cells.

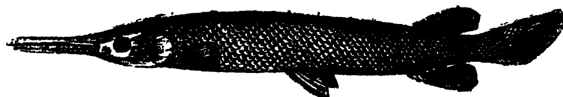


Fig. 52.—Bony Pike (*Lepidosteus osseus*).

The fishes of the genus *Lepidosteus* inhabit the rivers and lakes of America, especially in the warmer regions. Several species have been described by American authors as inhabiting the fresh waters of the United States; but of these some are no doubt mere varieties. They attain a considerable size, some of them being between two and three feet in length, and their flesh is said to be very good.

The *Lepidotidæ*—a nearly allied family, with two rows of fulcral scales on the margins of the fins—are distinguished from the preceding family by their homocercal structure and smaller teeth, which never exhibit the peculiar folded arrangement of their constituent parts which is characteristic of the Lepidosteidæ. The species of this family are all fossil.

The Ganoid fishes with a single row of fulcral scales on the fins are also known to us only by their fossil remains. Like the forms with double fulcra, they may be divided into two families, in accordance with the structure of the caudal extremity. The heterocercal species constitute the family of *Palæoniscidæ*, examples of which are found only in the older formations up to the Oolitic period. They have a single dorsal fin placed about the middle of the body, and the anal fin is also single, and situated near the caudal. The homocercal forms, forming the family *Dapediidæ*, resemble the preceding in the number and position of their fins, but the bodies of the vertebræ are ossified. They make their appearance in the oolite.

### Sub-order II.—Chondrostea, or Loricata.

**General Characters.**—The fishes belonging to this sub-order were arranged by most of the earlier naturalists amongst the Cartilaginous fish, of which they formed, with Cuvier, a peculiar order, characterized by having the free branchiæ and opercular

apparatus of the ordinary bony fishes. They are, in fact, distinguished from the other *living* species of the order Ganoidea by the nature of their skeleton, in which the centre of the vertebral column is represented by a simple, soft *chorda dorsalis*, without any indication of a division into separate vertebral bodies. The processes of the vertebræ are, however, generally distinctly ossified. The character of the dermal skeleton is also different. It consists of large, cellular bony plates, which are usually collected together so as to form a strong covering for the head, where they are firmly united to the cartilaginous skull, whilst the remainder of the body is either entirely naked or furnished with a few bony plates, separated by intervals of skin of greater or less extent. In a few species the skin is completely naked. In the recent forms the mouth is always placed on the lower surface of the head, at some little distance from the tip of the snout; but in some of the fossil species, which agree with this group in the general characters of the skeleton and the arrangement of the dermal plates, it is situated, as in the ordinary fishes, at the front of the head.

The greater part of the fossil species belong to the family *Cephalaspidæ*, in which not only the head, but even a considerable portion of the body, was covered with bony plates, giving these creatures a most singular aspect. So anomalous is the appearance of some of the species, in fact, that for a considerable time after the discovery of their remains, palæontologists were much divided in opinion with regard to their nature; and some of them were said to be gigantic water beetles, whilst others (such as

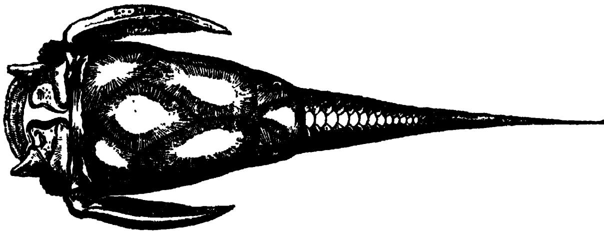


Fig. 53.—Pterichthys.

*Pterichthys*, Fig. 53) were considered to be allied to the King-crabs (*Limuli*), or to the Trilobites. The fins in these fishes were very imperfectly developed, and some of them appear to have been often entirely wanting. Thus, in the *Pterichthys*, the only representatives of the fins appear to be the singular jointed organs which project on each side of the anterior part of the body, and which are undoubtedly the pectoral fins, although certainly under a very curious form. The perpendicular fins are also very slightly developed, and the caudal fin appears to have been always deficient.

The remains of these fishes are found only in the most ancient fossiliferous strata of the earth's crust; they occur in the greatest abundance in the Old Red-sandstone, and entirely disappear in the strata above the carboniferous rocks.

**Divisions.**—The recent Chondrostea form two families, which however, agree very closely in their general form and organization, and differ principally in the character of the dermal covering. In the family of the Sturgeons, or *Acipenseridæ*, the body is elongated and fusiform; the head depressed, produced into a triangular snout, and covered with bony plates, and the body furnished with rows of large tubercular plates. The mouth is funnel-shaped and protrusible, placed on the under surface of the head, and

in front of it a few barbules depend from the snout. They possess opercular branchiæ, pseudo-branchiæ, and spiracles; the opercula are large, the fins well developed, the tail heterocercal, and furnished with fulcra along its upper margin.

The Sturgeons are generally of large size, and inhabit the seas of different parts of the world; but often ascend particular rivers in great abundance for the purpose of spawning. It is only during their progress towards, and their abode in, the fresh water that the fishery for the Sturgeons can be carried on; as during their sojourn in the sea they appear to frequent such deep water as to keep out of the reach of the nets, and Mr. Yarrell states that he has never heard of an instance of a Sturgeon being taken by line.

Two species are found on the British coasts; the *Acipenser sturio*, or common Sturgeon, is the best known of these. Its usual length is from five to six feet, but a specimen has been taken in Scotland measuring eight feet six inches in length, and weighing two hundred and three pounds; and Pennant mentions the capture of a fish of this species which weighed four hundred and sixty pounds. The flesh of the Sturgeon is regarded as a great delicacy, its flavour being compared to that of veal; and so highly was it esteemed in former days, that our Henry the First is said to have prohibited its being eaten at any other table than his own. Very recently, any Sturgeon taken in the Thames, within the jurisdiction of the Lord Mayor, was denominated a royal fish, from an old custom that such fish should be presented to the sovereign.

The common Sturgeon is far more abundant in the seas of the North of Europe than on our coasts; it also exists in the Caspian and Black Seas in great quantities, associated with other species, of which one, the Beluga (*Acipenser huso*, Fig. 54), attains an enormous size. This fish often measures twelve or fifteen feet in length, and weighs more than twelve hundred pounds; and Cuvier states that specimens have been seen weighing no less than three thousand pounds. It ascends the great rivers which empty themselves into the seas above mentioned, in company with the common sturgeon, and with two smaller species, the *A. Helops* and *A. Ruthenus*, of which the former attains the length of about four, and the latter of two or three feet. The *Acipenser Ruthenus*, or *Sterlet*, which abounds especially in the Caspian Sea, and ascends the Volga in great numbers, is regarded as the most delicate species of the genus; but the flesh of the Beluga and of the Scherg (*A. Helops*) is of inferior quality, and that of the former is even said to be occasionally unwholesome.

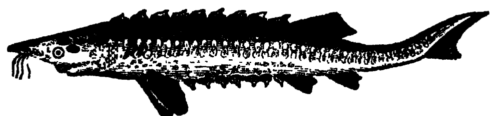


Fig. 54.—Beluga (*Acipenser huso*).

Nevertheless, this fish is, perhaps, the most important of its family, as, from its sound, or air-bladder, the most abundant supply of fine *isinglass* is prepared. The other species also furnish this substance, and to procure it vast quantities of them are captured in the rivers of Russia. Another article, prepared from the different species of Sturgeon, is the substance called *caviare*, which forms an important article of commerce in the countries bordering on the Mediterranean. It consists of the roe of the female fish, which is cleaned, washed with vinegar, and dried, when it is either pressed into small cakes, or packed in kegs. The roe in these fishes occupies a very great proportion of the body, occasionally constituting more than one-third of its total weight; and as upwards of one hundred thousand of the Beluga alone* are said to be taken

* The roe of this species sometimes weighs as much as eight hundred pounds.

annually in the Russian rivers, we may form some idea of the commercial importance of this article. The caviare prepared from the roe of the *Sterlet* is said to be far superior to that obtained from any other species; and Cuvier states that it is reserved for the Imperial court. The skin of the Beluga is employed by the Russians for harness leather; and the *chorda dorsalis* of several species is said to be cut in pieces, dried, and used as food in some countries. The Baltic and the American seas also abound in Sturgeons, the species found in the latter locality being distinct from those of Europe. They are taken in considerable quantities, and their flesh is often pickled and exported to other countries.

The *Spatularidæ*, forming the last family of the Ganoid fishes, resemble the true Sturgeons in their general form; but their skin is quite naked, and destitute of the bony plates which, in the fishes of the preceding family, cover the head and part of the body. They are also distinguished by having the snout enormously prolonged and compressed, so as to form a thin elongated leaf-like organ, which is sometimes nearly as long as the rest of the body. The opercular apertures are very large, and the hinder margins of the opercula are produced backwards into a membranous point, which attains nearly the middle of the body. The mouth is wide, and very different in its form from that of the Sturgeons; it is armed with numerous minute teeth whilst the animal is young; but these are lost as it increases in age. The species of this curious family are found only in the great rivers of North America; the first described was the *Spatularia folium* from the Mississippi.

## Order V.—Selachia.

**General Characters.**—The great order of the *Selachia*, including the Sharks and Rays, may be considered to correspond with the typical portion of the Chondropterygious or Cartilaginous fishes of Cuvier. That author, however, included amongst his cartilaginous fish the Sturgeons, which we have seen to belong to the Ganoid order, and the Lampreys and their allies, which, except in the soft texture of their skeletons, and the arrangement of the branchial openings, have certainly nothing in common with the highly-organised fishes arranged in the present order. The Selachia have generally been placed nearly at the bottom of the scale in the classification of fishes; but this opinion of their inferiority has arisen entirely from the imperfect ossification of their skeleton; in the perfection of their general organisation, they certainly exceed all the other members of the class, and in many respects approach the classes immediately above them so closely that Linnæus even removed them altogether from the class of Fishes, and placed them amongst the Reptiles as a peculiar order to which he gave the name of *Nantes*.

The skeleton in the Selachia is entirely of a cartilaginous nature. The skull consists of a cartilaginous capsule, composed of a single piece, without any indications of sutures. The structure of the jaws varies considerably. In the *Chimæridæ* the upper teeth are supported upon the front of the lower surface of the skull, which also takes the place of the palate; but in the Sharks and Rays there is a true moveable upper jaw bearing the teeth, and between this and the base of the skull are the rudiments of a true palate. The lower jaw always consists of a single cartilaginous arch.

The teeth are very variable in their form. In the Sharks, the most active and predaceous members of the order, the teeth are exceedingly sharp, compressed, and occasionally serrated at the edge; in the Rays the teeth also sometimes exhibit the same

trenchant character, but in many cases they are arranged in mosaic, and these different forms appear occasionally to be only sexual peculiarities. In some cases the teeth form broad, pavement-like plates, covering the surface of the jaws. The teeth are never inserted into the jaws, but are simply retained in their position by the strong skin of the gums. They are arranged in numerous rows upon the rounded edge of the jaws, those of the outermost row standing perpendicularly, and being the only ones in use, whilst those of the inner rows are inclined inwards, and only acquire the perpendicular position when they move forward to take the place of one of their fellows that has been worn out by long use. The spinal column is sometimes a simple *chorda dorsalis*, which occasionally exhibits indications of segmentation, and sometimes composed of a regular series of cartilaginous vertebræ, furnished with the same conical cavities as in the bony fishes The arches of the vertebræ are, however, generally cartilaginous, even in the forms with a continuous dorsal chord, and in those which have the bodies of the vertebræ cartilaginous, the bases of the processes are usually inserted into peculiar sockets of those bones.

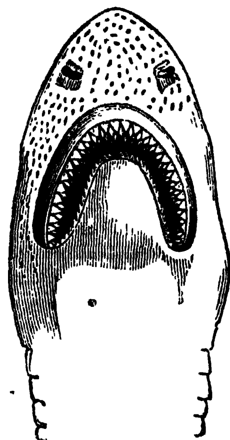


Fig. 55.—Mouth of Shark.

The pectoral fins are attached to a strong cartilaginous arch, which usually, as in the bony fishes, depends from the hinder part of the skull. The ventral fins are always situated at the hinder part of the abdomen, on each side of the anus; and in the males they are furnished with curious cylindrical appendages, which are probably organs of adhesion. The perpendicular fins vary considerably in number and position, as in the preceding groups of fishes, and some of them are frequently wanting. The tail is usually heterocercal. The fin rays are exceedingly numerous, and of a horny texture, very different from that of the rays of the fishes of any other group; but the fins are also frequently provided with a strong hollow spine, composed of dentine, and usually serrated behind; this is supported upon a moveable cartilaginous piece, and often constitutes a formidable weapon.

The skin is sometimes quite naked, but usually bears a number of larger or smaller fragments of dentine, which are sometimes in the form of scattered spines, separated by intervals of naked skin, but in other cases are distributed in minute grains over the whole surface.

The Selachia are especially distinguished from the other fishes by the structure of their branchiæ. The branchial arches are fixed, and the branchial laminæ, besides being attached by their bases to the arches, are also fixed by the whole of one margin to a series of partitions, which thus bear a series of laminæ on each side of them. In this manner a series of branchial sacs is formed, which open into the pharynx by separate slits, and also usually possess separate external apertures to allow the water employed in respiration to pass off. The usual number of these openings is five on each side; but in some cases there are six, and even seven of them. In the Chimæridæ there is, however, only a single external opening; and this character induced Cuvier to place these singular fishes with the Sturgeons in his order of Chondropterygii with free branchiæ, although the internal structure of the branchial apparatus is the same as that of the typical Selachia.

The arterial bulb in the Selachia exhibits the same muscular coat and apparatus of internal valves that we have already described as existing in the Ganoid fishes; but the valves are generally less numerous than in the recent species of that order. The intestine is also furnished with a spiral valve, which often attains an extraordinary degree of development. There are no pyloric cœca, but the pancreas is in a glandular form. The nervous system exhibits a marked superiority over that of the ordinary fishes, the volume of the cerebral hemispheres being much greater (see Fig. 15, B); and the optic nerves present the same arrangement as in the Ganoid fishes. The Selachia are also the only fishes in which the auditory cavity is in communication with the outer world; the eyes are in some cases furnished with nictitating membranes, and the nasal sacs are of very complicated construction.

The reproduction of these animals presents several remarkable peculiarities, and differs considerably from that of most fishes. Thus most of them produce living young, which are developed in an enlarged portion of the oviduct, where they lie free, and surrounded by an albuminous liquid, which appears to assist in their nutrition during the period of development. It is even said that in one species, at least, the yelk-sac attaches itself by means of little appendages to the walls of the oviduct, thus forming a connection with the parent such as we only meet with elsewhere amongst the Mammalia. Some species, on the other hand, produce ova, which are inclosed in hard, horny, quadrangular shells, usually furnished with a pair of filamentous processes at each extremity (Fig. 56). These egg-cases are furnished with slits to allow the passage of water to the embryo, which lies coiled up in their interior until its development is sufficiently advanced, when it makes its escape through an opening at the extremity towards which its head is situated. The filamentous processes of these egg-cases are said to serve for their attachment to sea-weeds, so as to prevent the young animal from being the sport of the waves; the empty cases are constantly to be found thrown up on the beach, and they are well known at the sea-side under the name of Mermaid's-purses, Sea-purses, &c.

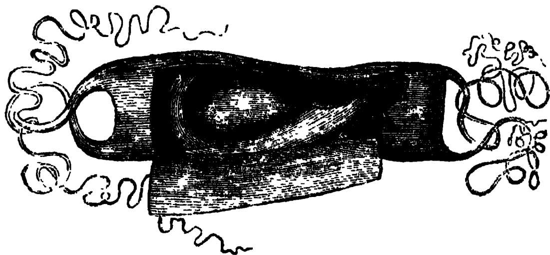


Fig. 56.—Egg-case and Young of Dog-fish.

The embryo exhibits one remarkable peculiarity which appears greatly to justify the position of this order in the immediate neighbourhood of the Batrachia. Before its exclusion the young fish is furnished with external filamentous branchiæ, like those which exist in the tadpoles or larvæ of the Batrachia, a character which we meet with in no other group of fishes.

The Selachia are all inhabitants of the sea, although some of them occasionally frequent the estuaries of large rivers. They are all of large or moderate size, some species attaining gigantic proportions, when their voracity renders them objects of terror to the inhabitants of the coasts on which they occur.

**Divisions.**—They may be divided into two primary groups or sub-orders—the

*Holocephala*, which may be recognized by their single branchial apertures on each side, and the *Plagiostomata*, in which each branchial sac has a separate opening.

SUB-ORDER I.—HOLOCEPHALA.

The Holocephala make the nearest approach to the Sturgeons, and were, in fact, included in the same order with them by Cuvier. They have a continuous *chorda dorsalis*, with cartilaginous neural arches and transverse processes. The skull is short and rounded, and its anterior margin takes the place of the upper jaw, and supports the teeth, which consist of broad plates, of which the upper jaw bears four, the lower one only two. The eyes are very large, but without eyelids. The nasal cavities are very large and convoluted; they open on the lower part of the snout, in front of the mouth, which is of small size. On each side of the neck there is a single branchial aperture, which is furnished with a sort of rudimentary cartilaginous operculum, and which leads down to five distinct branchial sacs, with separate openings into the pharynx.

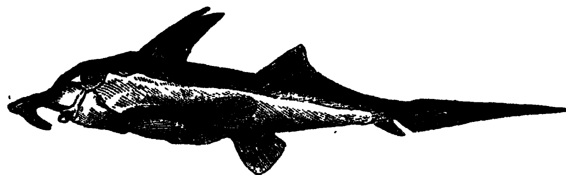


Fig. 57.—Southern Chimæra (*Callorhynchus australis*.)

There are two dorsal fins, of which the anterior is rather short, triangular, furnished in front with a very large spine, and situated immediately over the large, powerful pectoral fins; the anal fin is small, and the tail heterocercal. The skin is perfectly naked.

The Holocephala are all oviparous, and their eggs, like those of the Sharks and Rays, are inclosed in a strong, horny capsule. They form a single family, the *Chimæridæ;* Linnæus having applied the name *Chimæra* to them from their singular appearance, especially when badly stuffed.

The best known species is the Northern Chimæra (*Chimæra monstrosa*), which is called the *Sea-cat*, and the *King of the Herrings*, in different localities. It is three or four feet long, of a silvery colour, spotted with brown; the snout is obtusely conical, and the extremity of the tail is produced into a very long tapering filament. It is a native of the northern seas, and usually follows the shoals of Herrings during their periodical migrations towards the shore, feeding upon these and other small fishes; it is also said to feed on Medusæ and Crustacea. The males are furnished with bony appendages at the base of the ventral fins, and also with a singular plate, terminated by a spinous disc, on the crown of the head in front of the eyes; the possession of this appendage, coupled with its habit of following the Herrings, has no doubt given rise to the fanciful appellation referred to above. This fish occurs occasionally on the British coasts; its flesh is coarse, and very indifferent as food; but the oil furnished by its liver is said to be employed by the Norwegians in diseases of the eyes.

In the seas of the southern hemisphere, the place of the *Chimæra monstrosa* is taken by another species, the *Callorhynchus australis* (Fig. 57), so called from its having the snout produced into a cartilaginous process, which is bent backwards at the extremity, so as to acquire no small resemblance to a hoe. It is of about the same size as the northern Chimæra, and is of a silvery colour, tinged with yellowish brown. The tail is not produced into a filament.

## Sub-order II.—Plagiostomata.

**General Characters.**—In the Plagiostomata, the centre of the vertebral column is usually more or less ossified, and divided into separate vertebræ, and even where it still forms a continuous *chorda dorsalis*, the boundaries of the vertebræ are indicated by transverse partitions. The union of the vertebral column with the skull is effected by means of a joint, which contains a conical cavity. The skull, as in the preceding sub-order, forms a simple cartilaginous capsule; but its anterior margin no longer performs the office of a jaw, the upper jaw being formed of a separate cartilaginous arch. The mouth is very wide (Fig. 55), and placed quite on the lower surface of the body, at some distance from the extremity of the snout, which is greatly inflated to give room for the enormous nasal capsules. The mouth is always of an arched form, and contains numerous rows of teeth, of which the inner are continually coming up to replace those which have been long in use. The branchial sacs are completely separated, and furnished with distinct apertures for the passage of the water which has been employed in respiration; these, in the Sharks, are placed at the sides of the neck, but in the flattened Rays they are situated on the lower surface of the body, a little behind the mouth. On the upper surface of the head, behind the eyes, is a pair of spiracles, which communicate with the pharynx. The skin is almost always furnished with the hard bodies already described, either in the form of scattered spines, or of minute grains covering the whole skin.

**Divisions.**—These fishes are divided by Professor Müller into numerous families, which, however, may all be referred to one of two groups, the Sharks (*Squalina*), and the Rays (*Raiina*).

The Sharks are at once distinguished by their elongated, spindle-shaped bodies, their branchial apertures placed on the sides of the neck, and their pectoral fins of the ordinary form and position. The symmetrical tail is large and fleshy, furnished with powerful fins, which render it a most powerful agent in progression; the nose is usually conical and pointed, the mouth large, and armed with most formidable cutting teeth, and the upper surface of the head is frequently furnished with a pair of spiracles, although these apertures are often wanting. This group includes the numerous species of Sharks and Dog-fishes, which may be distributed into the following families.

The *Scylliidæ*, or Dog-fishes, have a short, blunt snout, an anal fin, two dorsal fins, placed further back than the ventrals, and small branchial apertures, of which a part stand over the base of the pectoral fins. The top of the head possesses spiracles, and the teeth are sharp and tongue-shaped, with three points, a large one in the middle, and a small one on each side; but some of the teeth, which appear to be specially intended for cutting, are finely serrated along both their edges. The Dog-fishes are also distinguished from the other Sharks by their oviparous reproduction; the egg-case, with its little inmate, has already been figured (Fig. 56). The Dog-fishes are amongst the smallest of the Sharks, the largest British species measuring no more than two or three feet in length. Three species inhabit the British seas, where one of them occurs in great abundance, and is often caught by lines intended for other fish. It is, however, of little or no value. Both species are of a reddish tint, mottled in the one with small black spots, and adorned in the other with a smaller number of large round black and white spots. The skin of these fishes is commonly used by cabinet-makers as a fine rasp; it is known to them by the name of "fish-skin."

The *Carcharidæ*, or true Sharks, have acute triangular teeth of very large size, two spineless dorsal fins, of which the anterior is situated above the space between the pectorals and ventrals, and a more or less forked tail (Fig. 58). The spiracles are wanting. To this family belong the large Sharks of hot climates, of the ferocity of which, in attacking even human beings when swimming, such wonderful stories are often related by travellers. Of these the most celebrated is the White Shark (*Carcharias vulgaris*, Fig. 58*), which appears to occur in almost all seas, is tolerably abundant in the Mediterranean, and, according to some naturalists, has even been taken near our own coasts. This terrible fish attains a length of twenty-five or thirty feet; its mouth is very wide, and armed with acute, serrated, cutting teeth, with which, if some of the accounts of travellers are to be believed, it can readily bite through the body of a man. It constantly follows ships in warm climates, apparently for the sake of the garbage and other matters which are thrown overboard; but sailors are generally averse to such a formidable neighbour, and means are soon taken to get rid of him. The Shark bites boldly at almost any bait of sufficient size to suit his enormous throat, and may generally be taken easily by putting a piece of pork upon a large hook attached to a chain, and trailing this tempting bait at the stern of the ship. When hauled on board the first operation is usually to cut off the tail, as its great strength renders its blows exceedingly dangerous.

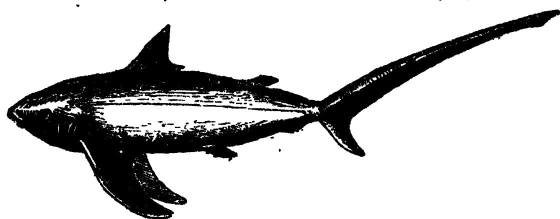


Fig. 58.—Thresher, or Fox Shark (*Carcharias Vulpes*).

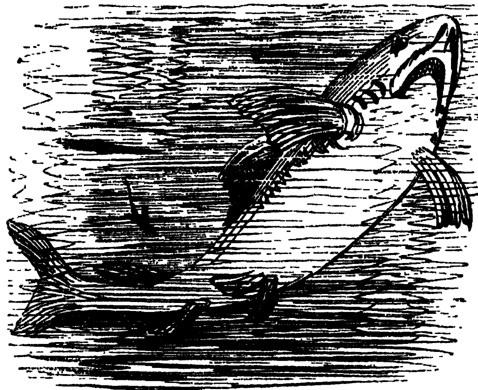


Fig. 58*.—White Shark (*Carcharias vulgaris*).

Another species, which, although an inhabitant of the Mediterranean, is not unfrequently met with on our south coasts, is the Blue Shark (*Carcharias glaucus*). It sometimes reaches the length of eight feet, and is an exceedingly bold and voracious animal, which is regarded by the fishermen as one of their greatest enemies. The Blue Sharks live almost entirely upon fish, of which they must devour a great number; and they often annoy the fishermen greatly by hanging about the boats, seizing the fish that are being drawn up, and not only biting through the lines for the legitimate purpose of getting off with their prey, but even sometimes, apparently, for the mere pleasure of the mischief. Sometimes, however, they get hooked when thus engaged, when, if they cannot bite through the line, they immediately roll themselves round so

as to wind the line upon their bodies; and Mr. Couch states that "this is sometimes done in such a complicated manner, that he has known a fisherman give up any attempt to unroll it as a hopeless task." To the drift nets employed in the Pilchard fishery, on the Cornish coast, it is an equally dangerous enemy, passing along the whole length of the net, and picking out the Pilchards by biting them away, together with the portion of the net in which they are entangled. Many of the old writers on natural history celebrate the affection of the Blue Shark for its young; and even in the present day it is a common belief amongst sea-faring people that at the approach of danger the young Sharks enter the mouth of their parent and take shelter in its belly.

Another British species is the Fox Shark (*Carcharias Vulpes*, Fig. 58), which is also known as the Sea Fox, the Sea Ape, and the Thresher; the latter name is said to be applied to it from its habit of defending itself by blows with its tail. It is said to attain a length of fifteen feet, and specimens have been taken in the British seas thirteen feet long. Its appearance is rendered very remarkable by the great length of the upper lobe of the tail.

The *Zygænidæ*, or Hammer-headed Sharks, are very closely allied to the Carcharidæ, and differ principally in the singular form of the head (Fig. 59), which is very broad, forming a projection on each side of the front of the body, at the extremity of which the eyes are situated. The head bears a considerable resemblance to the head of a hammer, whence the name commonly applied to these creatures. Several species of these curious fishes occur in various parts of the world; the common species, *Zygæna malleus*, is found in the Mediterranean, and also in the warm parts of the ocean, and attains a length of about twelve feet; it is very ferocious, and is even said to attack men when bathing.

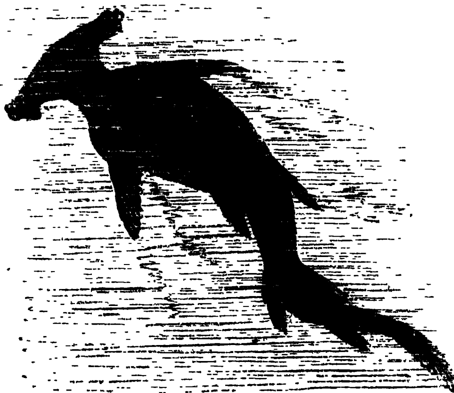


Fig. 59.—Hammer-headed Shark (*Zygæna malleus.*)

In the *Lamnidæ*, the two dorsal fins are destitute of spines, the spiracles are large, and the branchial apertures, which are of very large size, are all situated in front of the base of the pectoral fins. There is an anal fin; the nose is usually long and pyramidal, the mouth very wide, and the teeth lingulate, not serrated, but sometimes furnished with small lateral points.

In these Sharks, the caudal fin is broadly forked, and the two lobes are nearly symmetrical. Three species are found in the British seas. Of these the Porbeagle (*Lamna cornubica*), and the Beaumaris Shark (*L. monensis*), rarely attain a length of nine feet, whilst the third species, the Basking Shark (*Selachus maximus*), is the largest of the whole group of Sharks, measuring occasionally no less than thirty-six feet. Notwithstanding its great size, this fish appears to be the least ferocious of the Sharks, and its teeth are smaller in proportion than those of any other species. It appears to

be sluggish in its habits, frequently lying motionless, sunning itself at the surface of the water, from which circumstance the name of Sun-fish is given to it on the north coast of Ireland. When thus engaged, it will sometimes allow a boat to touch it before moving. It does not appear to feed on fishes, the stomach, when examined, containing a pulpy mass, apparently consisting of the remains of invertebrate animals; Linnæus states that it feeds on Medusæ, whilst Pennant attributes to it a vegetable diet. The branchial apertures are very large, surrounding the greater part of the neck. It is taken occasionally for the sake of the liver, which yields a large quantity of oil. The usual way in which it is captured is by the harpoon; but when struck with this instrument, it is said to plunge down into the water with such force and rapidity as to render it rather a dangerous prize.

The *Galeidæ* have an anal fin and spiracles; their two dorsal fins are destitute of spines, the caudal exceedingly unsymmetrical, and the spiracles are very small. Two species occur commonly in our seas. One of these, the common Tope (*Galeus vulgaris*), known on some parts of the coast as the Penny Dog and the Miller's Dog, attains a length of about six feet, and is very injurious to the fisheries. Its teeth are triangular, sharp, and serrated externally; and, like the Blue Shark, when caught on a line, it frequently bites through, and thus gets away; but if it fails in this, it has recourse to the same expedient of twisting the line round the body. Its liver furnishes an oil, and this is the only use that is made of it when caught. The other British species, the Smooth Hound (*Mustelus lævis*), although resembling the preceding in its form and general characters, is remarkably distinguished by the structure of its teeth, which are flat, and cover the jaws with a sort of mosaic, similar to that which prevails amongst the Rays. From this circumstance it is called the Ray-mouthed Dog in Cornwall. This fish is one of the smallest of the Sharks, and feeds principally upon Crustacea, which its pavement-like teeth are admirably adapted for crushing.

The *Notidanidæ* resemble the Lamnidæ in many respects; but they have only a single dorsal fin, and the branchial apertures are six or seven in number. These are comparatively small fishes, measuring about three feet in length; two of them are common in the Mediterranean.

The *Cestraciontidæ*, of which we have only a single living representative, although their fossil remains are tolerably numerous in some of the older formations, are distinguished by the form of their teeth, which are arranged upon the jaws in a pavement-like form, those in front being pointed, whilst the hinder ones are converted into broad, flat grinders. The form of the body is short and stout; the head is large, with prominent eyes; and the mouth is placed at the front of the head. There are two dorsal fins, each furnished with a short, stout spine, a single anal fin, and a pair of spiracles. The only species, the *Cestracion Phillipsii*, is found in the Eastern seas, especially on the coast of New Holland.

In the *Spinacidæ* the general form of the body resembles that of the Galeidæ, and, as in those fishes, there are two dorsal fins, but the anal fin is wanting. The teeth are small and acute; the spiracles are distinct; and both the dorsal fins are furnished with a strong spine. A very common European species is the Picked Dog-fish (*Spinax Acanthias*), which is found in the European seas, and attains a length of about three feet. They are said to afford the best food of any of the Sharks, and are commonly brought to the markets of sea-side towns. The flesh is often dried; the liver yields a large quantity of oil; and when they occur, as they sometimes do, in vast quantities, their intestines are employed as manure. Mr. Couch states that he has heard of twenty

thousand of them being taken in a sean at one time. It is, however, as a general rule, rather a nuisance to the fishermen, often biting off great numbers of their hooks. The spines of the dorsal fins are employed by the Picked Dog-fish as weapons of offence; it bends itself into the form of a bow, and then, by a sudden motion, strikes out with great force; and so accurate is its aim said to be, that if it be touched upon the head, it will inflict a wound upon the aggressor without the least injury to its own skin.

The *Scymnidæ* resemble the Spinacidæ in most of their characters, including the absence of the anal fin, but the dorsals are destitute of the strong spines characteristic of the preceding family. The Scymnidæ are also shorter and thicker in the body, and the lobes of the caudal fin are more equal. Some species of this family attain a considerable size, the Greenland Shark (*Scymnus borealis*) sometimes measuring upwards of fourteen feet in length. It is occasionally found on the northern coasts of this country, but generally inhabits the Arctic seas, where it is one of the greatest enemies of the Whales, attacking and biting those enormous creatures with the greatest pertinacity. When it meets with a dead whale, it scoops hemispherical pieces out of the body with its enormous jaws, which border a mouth of from twenty to twenty-four inches in breadth; but although the Sharks are constant attendants upon the whale-fishers when they are engaged in cutting the blubber from their captures, and the men not unfrequently slip into the water amongst them, Mr. Scoresby states that he never heard of an instance of their being attacked. It is exceedingly tenacious of life, and so indifferent to wounds that it will return again to its banquet after having been driven off by a stab with a knife which might have been supposed quite sufficient for its destruction. When cut up, also, the different parts of the body appear to retain a certain amount of life for some hours, and even after decapitation it is said not to be safe to trust the hand between its formidable jaws. Whales, however, are not the only food of the Greenland Shark; it condescends also to devour small fishes and crabs. It appears to be particularly liable to the attacks of a parasitic crustaceous animal, one or two inches in length,* belonging to the family Lernæidæ (vol. i., p. 298), which attaches itself to the eyes, and occurs so constantly in this situation that it was formerly regarded as a peculiar natural appendage of the eye. This parasite, no doubt, has a very injurious effect upon the sight of the animal; and the sailors commonly believe that the Greenland Shark is totally blind, as it never exhibits any desire to escape, even when threatened with a blow from a knife or lance. Several other species of this family are found in the seas of different parts of the world.

The *Squatinidæ*, at the first glance, exhibit a considerable resemblance to the fishes of the following group, the body being much depressed, and the pectoral and ventral fins large and broad, giving them a discoid form. Like the fishes of the preceding families, they are destitute of an anal fin, and have a pair of spiracles on the top of the head, which is very broad, and bears the eyes on its upper surface instead of on the sides. The mouth is very wide, and situated quite at the front of the head; and the branchial orifices are long, and placed in a cleft which separates the large pectoral fins from the head. Both the pectoral and ventral fins are broad and extended laterally; there are two dorsal fins placed upon the caudal portion of the body behind the ventrals; the anal fin is wanting, and the caudal is nearly, or quite, symmetrical.

The typical species of this family, the *Squatina angelus*, is not uncommon in our seas; it is known both in England, and in several other countries, by the name of the Angel, which certainly, as hinted by Mr. Yarrell, was never given to it for its beauty. It is

* *Lernæa elongata* of Grant.

also called the Monk-fish in some places, probably from the hooded appearance of its head; and Mr. Donovan states that its form has also attained for it the name of the Fiddle-fish. It is said sometimes to attain a length of seven or eight feet, and is an exceedingly voracious fish, swimming close to the bottom of the water, and feeding principally on the common flat fishes, which are to be met with in abundance in such situations. Its flesh was formerly held in some esteem, but it is now considered coarse and seldom eaten. The skin, however, is much used for polishing cabinet work, and also affords a fine sort of shagreen. A species found in the Mediterranean, the *Squatina aculeata*, is distinguished by having a row of strong spines along the back.

The second group of the Plagiostomata, the *Raiina*, including the fishes commonly known as Rays, are distinguished at the first glance by the singular flattened discoid form of their bodies. The greater part of this disc is made up of the pectoral fins, which are extremely large, and are supported upon a remarkable modification of the bones of the anterior members. The scapular arch is firmly attached to the hinder part of the head, and its two sides are also united above the vertebræ of what may be called the cervical region, which are amalgamated together so as to form a continuous cylinder. The two sides of the scapular arch also unite below, so that they form a complete ring, from each side of which long curved cartilages are given off, which serve to support the rays of the pectoral fins. These cartilaginous supports not only pass backwards from the scapular arch along the sides of the body, but also extend in front of it to the sides of the head, where they unite with other cartilages springing from the apex of the skull, which also support fin rays, so that the whole of both sides of the body, from the point of the snout to the base of the tail, is usually margined with a broad fin. The rays supporting these fins are composed of numerous small cartilaginous joints, and the fins themselves are usually formed by a thick layer of muscles. At the extremity of the body, close to the anus, the ventral fins are situated; in the males they are furnished with peculiar appendages, like those of the Sharks. The perpendicular fins are very variable in their development, but always of small size; the caudal fin is often wanting, and the dorsal and anal fins, when present, are always placed upon the tail, often close to its extremity, and the former are frequently furnished with long spines, similar to those of many Sharks, which sometimes exist without a fin, forming a most formidable weapon, with which the fishes are said to inflict dangerous wounds.

The eyes are situated on the upper surface; but it must be borne in mind that this is the back of the animal, and not the side, as in the ordinary flat fishes; behind the eyes are a pair of large spiracles. The lower, or ventral surface, is very flat, and upon it are situated the orifices of the nose and the mouth, the branchial apertures (five on each side), and the anus. The mouth is smaller in proportion than in the Sharks, and the jaws are covered either with numerous rows of small pointed teeth, or with a sort of mosaic flattened molars, which sometimes take the form of broad bony plates. It is remarkable that in some species the adult males possess teeth of the former description, whilst the young males and the females are furnished with grinding teeth. The skin is naked, but in most cases beset with a considerable number of spines, or thorns, which are sometimes scattered over the surface of the body, sometimes arranged in rows, especially along the tail. The structure of these spines is very peculiar. They consist of a sort of cartilaginous cup imbedded in the skin, from the concavity of which springs an acute spine formed entirely of dentine, and in many cases exactly resembling a true tooth in its structure. They are of very various sizes, sometimes mere prickles, whilst in other cases they constitute most formidable offensive weapons.

The Rays are all oviparous, and their eggs are inclosed in brown, leathery capsules of a quadrangular form, like those of the Dog-fishes, and furnished, like these, with elongated processes at their angles. They are all marine, and many of them attain a very large size. Some of them, in fact, acquire almost gigantic proportions, and weigh several hundredweights. We are told by some writers, that in Marseilles they may occasionally be seen so large, that when they are hung from the second floor of a house the tail will still touch the ground; and there is a record of the capture of a gigantic Ray on the coast of New Jersey which required the united efforts of six oxen, two horses, and two-and-twenty men, to get it safely landed! This fish was described as measuring eighteen feet in diameter, and its weight is said to have been five tons. Another enormous species is said to be an object of great terror to the pearl divers, as it occasionally passes over them, and holds them down till they are drowned; but the degree of dependence to be placed on these statements is very doubtful. Their habits are very predacious; they keep close to the bottom, moving about with a peculiar sliding action in pursuit of the small fishes, Mollusca and Crustacea, which constitute their ordinary food.

**Divisions.**—Professor Müller divides the Rays into six families. Of these the *Rhinobatidæ* appear to unite the characters of the Sharks and Rays in the greatest degree, resembling the former in the general conformation of the body, and even to a great extent in the position of the fins, the pectoral fins being even smaller than those of the Angel Sharks. The first dorsal fin is situated above the ventrals; the caudal is well developed and unsymmetrical; and their teeth are in the form of mosaic.

The fishes of this family inhabit the seas of most parts of the world, but none have been taken on the British coasts. A Brazilian species, *Rhinobatus electricus*, is said to possess electrical properties; but this statement requires confirmation. The most singular form, and the one which exhibits the closest resemblance to the Sharks, is the Saw-fish (*Pristis antiquorum*, Fig. 60), which has been associated with the Sharks by some authors, and might, perhaps, be regarded with justice as the type of a distinct family. The most remarkable character presented by this fish consists in the prolongation of the point of the snout into a sword-like organ, which is armed along its edges with strong, tooth-like spines. With this formidable weapon the Saw-fish attacks even the largest Cetaceous animals, upon which it often inflicts very serious injuries. The true teeth are very small. The species of Saw-fish, of which it is probable there are several, are distributed in the seas of most parts of the world; but they rarely approach the shores. They often attain a length of twelve or fifteen feet.

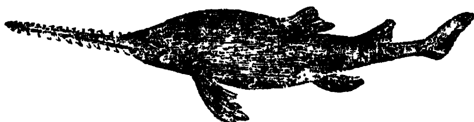


Fig. 60.—Saw-fish (*Pristis antiquorum*).

From the Rhinobatidæ we pass to the family of *Torpedinidæ*, or Electric Rays, distinguished by their rounded smooth bodies and by the possession of an electrical apparatus. The latter is disposed in two masses, one on each side of the skull, occupying the space between that capsule and the base of the pectoral fin. It is composed of a multitude of perpendicular gelatinous columns, separated by membranous partitions, which receive an immense number of fine nervous threads, derived from the eighth pair of nerves (*nervi vagi*). Nearly twenty species of this singular family are known; they

inhabit the seas of all parts of the world, and all probably possess electrical powers. Two or three species are found in the European seas, especially in the Mediterranean, and one or two of these have occurred on the British coasts; but there appears to be some doubt as to the actual species taken by our fishermen. The electrical powers of the Torpedo were well known to the ancients; and "as long ago as the time of Dioscorides the shock communicated by this fish was recommended for medical purposes, and especially for pains of the head; and this may be considered as the earliest record of the application of electricity to medicine. In later times it was applied to the cure of gout, the patient being directed to keep his foot on the fish until the numbness extended to the knees"—(*Yarrell.*) The real object of the electrical powers with which this and a few other fishes are endowed is not yet very clearly ascertained; and we can only judge from probability that this property is given them partly for their protection from danger, and partly to enable them to obtain food; and this latter office is probably one of great importance to the Torpedo, which is exceedingly slow in its movements. Mr. Couch also thinks that the electricity of this animal may have some influence upon the digestibility of the animals killed by it, rendering them "more readily disposed to pass into a state of decomposition, in which condition the digestive powers more speedily and effectually act upon them." He adds, "if any creature more than others might seem to require such a preparation of its food, it is the Cramp-ray, the whole canal of whose intestine is not more than half as long as the stomach."

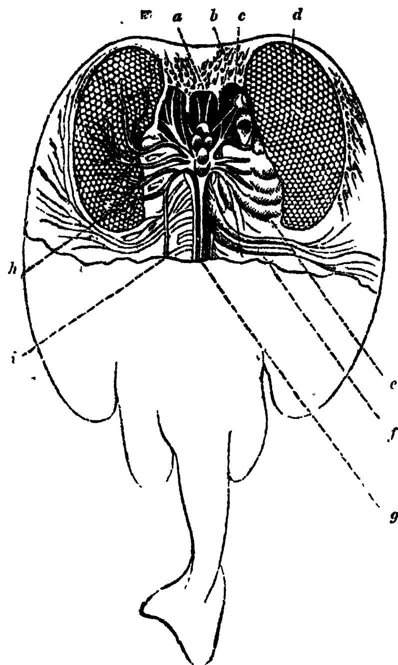


Fig. 61.—Anatomy of the Torpedo. The anterior part of the dorsal skin is removed, showing the electrical organs, brain, and nerves.

*a*, brain; *b*, skin, with its glands; *c*, eye, with the spiracle behind it; *d*, electrical organ; *e*, branchiæ; *f*, nerves running to the pectoral fin; *g*, spinal chord; *h*, branches of the *nervus vagus* passing to the electrical organ; *i*, lateral nerve.

The True Rays, or *Raiidæ*, have the snout more or less pointed, frequently produced, and the disc formed by the body and pectoral fins is usually of a rhomboidal figure. The tail is slender, and bears two small dorsal fins near the extremity; the caudal fin is also sometimes present. To this family belong all the best known species, including the Skates and Thornback so common in our markets. The British seas are inhabited by eight or nine species, several of which are very common, and some of them attain a large size; Pennant mentions a Skate that weighed two hundred pounds.

The most abundant species is the Thornback (*Raja clavata*, Fig. 62); and this and the Homelyn Ray (*R. maculata*) are the species most commonly brought to the London

market, where they are both sold as Skate. The females are usually denominated *maids*. The Sharp-nosed Ray (*R. oxyrhynchus*) is said by Mr. Yarrell to be the favourite species with the French, whose boats frequently visit Plymouth during Lent to purchase Skate. The Raiidæ are exceedingly voracious animals, devouring great numbers of small fishes, Crustacea and Mollusca; and the strength of their jaws is so great that they crush the hard shells of the latter animals without difficulty. They are taken both by net and line; when hooked, some of them struggle violently.

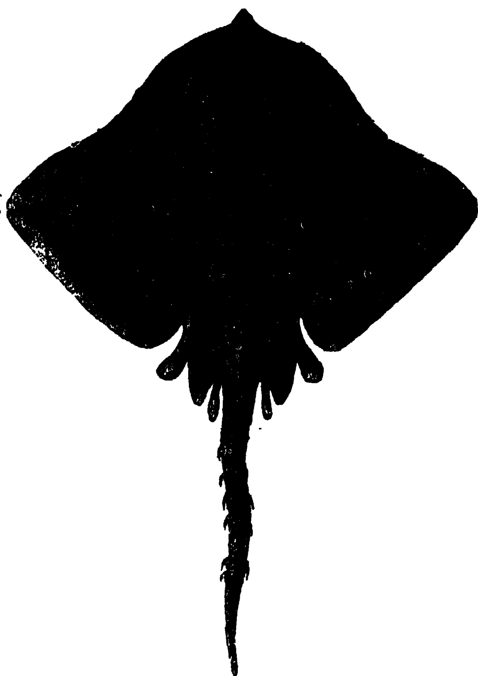


Fig. 62.—Thornback (*Raja clavata*).

In the family *Trygonidæ*, or the Sting Rays, the tail is armed with a long, denticulated spine, but bears no dorsal fin; the pectoral fins are large, and unite in front of the head, and the teeth are of small size. The Sting Ray is not uncommon in the Mediterranean; it was well known to the ancients, who attributed the most extraordinary venomous powers to its spine, which, no doubt, from its barbed structure, must inflict an exceedingly painful wound. It seems probable, from the observations of some writers, that this spine is deciduous, as specimens have been seen with a second small spine close to the base of the first. The spines of some species of Trygonidæ are often used by the natives of savage countries to form barbed spear and arrow heads.

According to Mr. Couch, the common Sting Ray (*Trygon pastinaca*) of the Mediterranean, which occurs pretty frequently on our south coast, defends itself in a manner that "shows its consciousness of the formidable weapon it carries on its tail. When seized or terrified, its habit is to twist its long, slender, and flexible tail round the object of attack, and, with the serrated spine, tear the surface, lacerating it in a manner calculated to produce violent inflammation." It is also said occasionally to strike its prey first with the spine, and afterwards to secure it by twisting the tail round it. Its flesh is said to be very bad.

Nearly allied to the Sting Rays is the curious family of the *Cephalopteridæ*, which agree with the former in having the jaws armed with numerous small teeth, and the tail with a long, barbed spine; but differ in the form of the pectoral fins, and in having a small dorsal fin. The head in these fishes projects a little beyond the anterior margin of the pectoral fins, and is furnished with a pair of curious little fins,

which stand out in front of it like horns. The pectoral fins are very wide and pointed. An enormous species, the *Cephaloptera giorna*, is found in the Mediterranean; and it seems probable that if there be any truth in the statements already referred to, regarding the gigantic enemy of the pearl fishers, the Ray in question would belong to this group. A specimen of a *Cephaloptera* has been taken upon the Irish coast, but Mr. Yarrell was unable to determine the species; it measured forty-five inches across the pectoral fins.

The *Myliobatidæ*, or Eagle Rays, resemble the preceding fishes in most of their characters; they are, however, destitute of the small horn-like fins on the front of the head, and the jaws are covered with broad hexagonal plates instead of teeth. The tail, like that of the *Cephalopteridæ*, is very long and slender, armed with a strong spine and furnished with a small dorsal fin, and the pectorals are very broad and do not meet in front of the head. These fishes are commonly known as Eagle Rays, from the great size of the pectoral fins, which present a considerable resemblance to a pair of wings; they are also called Whip Rays, on account of the form of the tail.

The Eagle Ray (*Myliobatis aquila*) is not uncommon in the Mediterranean, where the wounds inflicted by its spine are so much dreaded by the fishermen, that they always cut off the tail as soon as the fish comes within reach. Several other species are found in the seas of warm climates.

With the Rays terminates the class of Fishes, the only class of strictly aquatic vertebrated animals, and we must now pass to a singular group which, although they possess gills at some period of their existence, always subsequently acquire lungs, and become air-breathing creatures. These are the

## Class II.—Batrachia.

**General Characters.**—The singular animals forming this small class have been, and still are, included under the Reptiles by many naturalists. They appear, however, to possess so many remarkable characters, that they may very justly be regarded as constituting a distinct class, approaching the Fishes on the one hand, especially during their earlier stages of development, and, on the other, presenting a considerable resemblance to the Reptiles in the mature forms of their higher species.

The class, in fact, forms a distinct transition from the strictly aquatic Fishes to the strictly air-breathing Reptiles; and, as might be expected in a group of this nature, the forms, and even the organization of the animals composing it, are exceedingly various. Thus in the lower orders, which approach most closely to the preceding class, we meet with completely fish-like creatures, possessing permanent branchiæ, and in which the limbs are reduced to a rudimentary condition, and the tail is flattened and surrounded by a fin; in fact, zoologists are still divided in opinion as to whether one of these orders should be referred to this or the preceding class. With the exception of a remarkable order of apodal terrestrial animals, we find that as we advance in the class the limbs are gradually more and more developed, and fitted more especially for terrestrial progression; many of the higher forms are capable of very active motion on the ground, and some even have their habitual residence in trees.

The structure of the skeleton also exhibits great differences. The spinal column in some is composed of a continuous *chorda dorsalis*, inclosed in a fibrous sheath, but furnished with bony superior and inferior arches for the protection of the spinal cord and principal blood-vessels. In others we meet with a repetition of the vertebral column of the bony fishes, composed of separate vertebræ, of which the bodies contain

double conical cavities; whilst in the highest forms the vertebræ are articulated together by a sort of ball-and-socket joint. The vertebræ are usually furnished with long transverse processes, which appear to take the place of ribs; the latter are deficient throughout the whole class. The development of the skull partakes of this variable character. In the species with a *chorda dorsalis* the skull is formed of a simple cartilaginous capsule, with which the *chorda* is completely continuous; and the only indications of ossification are to be found in the lateral portions of the occipital bone. In the higher forms the skull is completely ossified; it is always of a broad and flattened form, with enormously large orbits, and possesses one constant character, which enables us to distinguish readily between the skull of a Batrachian and that of a true Reptile; the occipital bone is always furnished with two lateral condyles, which fit into corresponding sockets in the first vertebra of the neck. The bones of the upper jaw and palate form a broad arch, which is always firmly attached to the skull; the maxillary and intermaxillary bones assist in the formation of the edge of the mouth, and both these and the palatine bones are usually furnished with teeth. The lower jaw is articulated to a bony process, which usually projects more or less backwards from its point of attachment to the skull, so that the opening of the mouth may not unfrequently extend beyond the base of the skull. The hyoid bone is generally of considerable size, and in many cases gives attachment to a series of branchial arches, which, however, rarely reach the skull, and in the higher forms are reduced to a rudimentary condition.

Very few of the Batrachia are quite destitute of limbs, but several possess only a single pair. In the most fish-like forms the anterior limbs are attached, as in the fishes, to the back of the skull; but in all the others the scapular arch is distinct. The structure of the pelvic arch, and the development of the moveable bones of the limbs, varies greatly in the different orders into which the class is divided; but as their modifications will be described in characterising those groups, it will be unnecessary to dwell further upon them here.

In the majority of the Batrachia the skin is smooth and naked. It is composed of a soft corium, which usually lies loosely about the body, and is covered by a thin colourless epidermis; it frequently contains numerous glandular organs, which secrete an acrid fluid of a disagreeable odour. A few species are covered with minute horny scales, resembling those of the bony fishes in their structure and arrangement, and some have larger scales of a peculiar composite nature, which have been regarded as analogous with those of the Ganoid fishes.

In the development of the nervous system and the organs of the senses, the Batrachia, as a class, exhibit a slight advance upon the Fishes; and the cerebral hemispheres generally constitute the greater part of the brain. The nasal cavities are separated by a partition, and always open into the mouth. The eyes are sometimes rudimentary, and even concealed beneath the skin; but in most of these animals the organs of sight are well formed. In the Frogs they are exceedingly moveable, protected by eyelids, and furnished with a nictitating membrane. In most of the tailed Batrachia the ear exhibits but little advance from the condition of that organ in Fishes; but in the Frogs it has an external opening, furnished with a tympanic membrane, and the labyrinth consists of three semicircular canals and a sac, which is filled with microscopic calcareous crystals.

The mouth in these animals is always of large size, and almost always armed with small conical teeth. In a few species the jaws are unarmed, and in others the teeth are in the form of small perpendicular plates. The tongue is usually of large size, and

is often capable of being protruded from the mouth to a considerable distance, when it is employed in the capture of insects. The intestinal canal is short; the liver is large, and usually divided into two lobes; the gall bladder, pancreas, and spleen are always present.

The structure of the respiratory organs indicates more clearly than any other part of their organization the intermediate nature of these animals. They all possess lungs; but during their young or larval condition they are always furnished with branchiæ, and these, in many instances, are persistent throughout the life of the animal. The form and arrangement of the branchial organs will be described hereafter. The heart is composed of three chambers, a single muscular ventricle, and two membranous auricles; but in some species the partition between the latter is imperfect. The arterial bulb is surrounded by a distinct muscular coat, as in the Ganoid and Selachian fishes; and from the continuation of this the arteries running to the branchiæ and lungs are given off.

The Batrachia are all strictly oviparous animals, although in some species the eggs are retained in or upon the body of the parent until the young have attained a certain degree of development. As a general rule, the ova are impregnated by the male at the moment of their leaving the abdomen of the female; the eggs are united by a glutinous matter into masses or long chains, which may be constantly seen floating in the waters frequented by these animals.

The development of the young exhibits many points of great interest. On leaving the egg, the young animals are very different in form from their parents, and they undergo a considerable series of transformations before arriving at their final form. In their earliest stage (Fig. 63, *a*) they are well known as tadpoles—little, fish-like creatures with broad heads, followed immediately by a sac-like belly, and terminating posteriorly in a long compressed tail. The mouth is placed at the lower part of the front of the head, and is furnished with a pair of horny jaws, with which the little creatures feed upon the animalcula which form its nourishment. Whilst still very young, the tadpole is furnished with external gills; these soon disappear in the young of the frog, but in the tadpoles of the newts they remain for some time, and acquire a considerable size (Fig. 7). As the tadpole increases in size, the tail acquires greater breadth, and by degrees the limbs burst forth. It is remarkable that in the frogs the hinder legs are the first to make their appearance (Fig. 63, *b*), whilst in the newts the fore-legs precede the posterior pair. In the tadpole of the frog the hind-legs generally appear some little time before the others, and even after the fore-limbs have been developed the tail still continues to be the principal organ of motion (*c*); but when these are fully formed, the large tail gradually disappears, and even before it has quite gone the young frogs often quit the

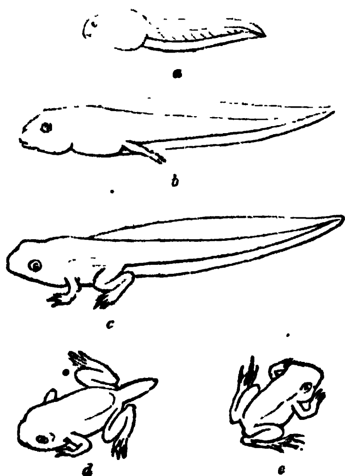



**Fig. 63.**—Development of the Frog.
*a*, Tadpole in its first stage; *b*, with hind legs; *c*, with two pairs of legs and well-developed tail; *d*, young Frog, with the remains of the tail; *e*, when completely developed.

water (*d*), and the remainder of the useless appendage is got rid of afterwards (*e*). In the newts and the other tailed Batrachia, the process is very similar, except that the tail is not cast off. But during the progress of these external changes, modifications of a not less important character are taking place in the internal organs. The branchial apparatus at first exhibits the arrangement shown in Figure 64, in which the circulation goes on exactly as in the fishes. Thus the blood, driven from the arterial bulb through the branchiæ, is again collected in the branchial veins, of which two pairs assist in the formation of the great aorta of the body, whilst the other pair is distributed in the head. The pulmonary arteries first make their appearance in a very rudimentary form, springing from the branchial vessels; but as the lungs are developed, and the aerial respiration commences, they rapidly increase in size, whilst the branchiæ contract in the same proportion. This condition of the respiratory apparatus is shown in Fig. 65, which may also be considered to represent the state of these organs in the Batrachia with persistent branchiæ. In the strictly air-breathing species, however, the change goes still further—the branches (1, 2, 3) uniting the branchial arteries acquire a much greater development, and gradually divert more and more of the blood from the branchiæ, which quickly disappear altogether (Fig. 66); the anterior branchial

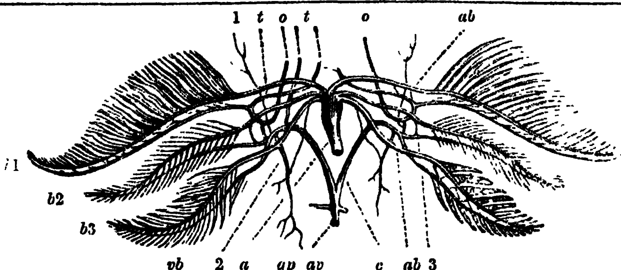


Fig. 64.—Breathing Apparatus of the Larva of a Salamander.
*a*, the arterial bulb, giving rise to three pairs of branchial arteries, *ab*; *b* 1, 2, 3, the three pairs of branchiæ; *t*, arteries running to the head, formed from the first branchial vein; *c*, vessel formed by the union of the two hinder branchial veins, and uniting with that of the other side to form the aorta, *av*; *ap*, rudimentary pulmonary artery; 1, 2, 3, branches uniting the branchial arteries and veins.

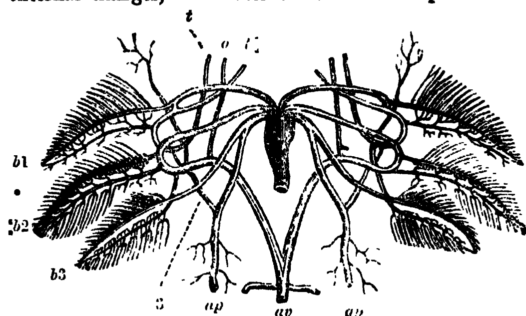


Fig. 65.—The Vessels of the same Larva, after the commencement of aerial respiration. The letters have the same meaning as in the preceding figure.

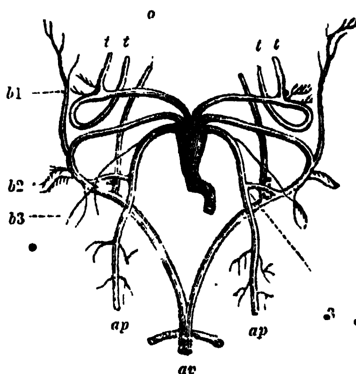


Fig. 66.—The Vessels in the Perfect Animal.

arches then become converted into the arteries for the head and eyes, the second pair go to form the aorta, whilst the place of the third is taken by the preliminary arteries, by the agency of which the whole business of respiration is now carried on.

The Batrachia are essentially inhabitants of the warmer countries of the earth; they abound particularly in the tropical zones. Although they are by no means confined to the water, they are always found in damp places, as moisture appears to be absolutely necessary for their existence. The larvæ feed entirely upon animalcula; but the mature animals derive their subsistence principally from insects and worms, in the capture of which they often display great agility. In temperate climates they pass the winter in a torpid state, buried in the mud of ponds and ditches, without food or air; but under other circumstances the access of air must certainly be necessary, and the accounts which have repeatedly been given of the occurrence of toads in the heart of a *solid* block of stone, must always be received with some little allowance for the surprise which would naturally be created by the sudden appearance of the creature in an unexpected situation, such as the inside of a tree, or of an *apparently* solid stone. It is well known that, under favourable circumstances of air and moisture, the Toads will live for months without food, so that if those two grand requisites be granted, we may account for the most surprising of these cases without much difficulty.

**Divisions.**—The class Batrachia may be readily divided into five very distinct orders—namely, the *Lepidota*, with a fish-like scaly body, four simple limbs, and permanent gills; the *Apoda*, with a vermiform body and no legs; the *Amphipneusta*, with naked skin, two or four legs, and permanent gills; the *Urodela*, breathing by lungs alone, and retaining the tail in the perfect state; and the *Anoura*, in which the tail is wanting in the fully developed animal.

### Order I.—Lepidota.

This order includes only three singular animals, which have been placed by different observers alternately amongst the Fishes and the Batrachia; and it must be confessed that the claims of the two groups are so nearly balanced that it depends entirely upon the stress that may be laid upon different characters, under which class it shall be placed. The body is completely fish-like in its form, covered with rounded scales, laid over one another exactly like fish scales; and immediately behind the head there is a small branchial aperture. The limbs are simple styliform organs, the anterior pair, like the pectoral fins of a fish, being attached to the back of the head, and the fin that runs round the posterior extremity of the body is supported by a series of horny rays. The scales with which the body is covered are of a peculiar structure; they appear to be composed of numerous small mosaic-like pieces. The skeleton consists of a continuous *chorda*, with bony arches, and the skull is cartilaginous, with a few bony plates. The teeth are in the form of perpendicular cutting plates. The branchiæ are attached to three complete arches, between which there is a similar number of slits opening into the pharynx, and there are also two other arches which bear no branchial laminæ.

The nasal cavities open into the mouth, and an opening into the pharynx leads to a pair of cellular lungs, which receive venous blood from the heart, and return it, when arterialized, into the aorta. These characters appear to prove that the animals of this order belong rather to the Batrachia than to the Fishes, especially as the auricle of

the heart is distinctly separated into two chambers, although the partition between them is imperfect. Another important character is that one species, at least, possesses external branchiæ in the perfect state, a structure which does not occur in any Fish.


Fig. 67.—Lepidosiren paradoxa.

Three species of this curious order are already known; they are found in the fresh waters of the hot regions of South America and Africa. The South American species (*Lepidosiren paradoxa*, Fig. 67) is between two and three feet in length; and another species (the *L. annectens*), of about a foot long, is found in the Gambia. During the dry season these creatures bury themselves in the mud; and one of them is said to make itself a sort of nest in which to pass the period of torpidity. In these burrows they await the return of the wet season, which recalls them to their aquatic life. The Gambian species is said to pass nine months of the year in this torpid state.

## Order II.—Apoda.

The animals belonging to this order also present such anomalous characters, that naturalists have long been doubtful whether they should be placed amongst the Batrachia, or with the Snakes amongst the Reptiles. In the form of the body they closely resemble large earthworms; they are totally destitute of limbs, and covered with a soft, viscous skin, which is annulated and wrinkled, and contains numerous minute horny scales, exactly resembling those of Fishes. The mouth is of moderate size; the eyes very small, and sometimes entirely wanting; and the anus is situated at the hinder extremity of the body, without the least indication of a tail.

For many years great difficulty was experienced in assigning a place to these curious creatures, as it was not known whether they passed through any metamorphosis; and they were accordingly arranged by Cuvier, and many other zoologists, amongst the Serpents. It is found, however, that in the young state there is an aperture in the side of the neck, which leads down to a system of branchiæ.

The Apodal Batrachia form a single family, the *Cæciliidæ*, so called in consequence of the minute size and occasional absence of the eyes. They live in the tropical regions of both hemispheres, where they burrow in marshy ground, like earthworms, in pursuit of the larvæ of insects, upon which they feed. The species generally measure from one to two feet in length; but Cuvier states that he possessed the skeleton of a *Cæcilia* which was more than six feet in length, and contained two hundred and twenty-five vertebræ.

## Order III.—Amphipneusta.

**General Characters.**—This and the following order agree in having the skin perfectly naked, the body elongated and produced behind into a permanent tail, and the limbs more or less developed.

The *Amphipneusta* are distinguished principally by the permanent nature of the branchial organs (Fig. 68), which project from the sides of the neck during the whole life of the animal. The lungs, although existing, are in a comparatively rudimentary

state, and there can be no doubt that the respiration of these animals is essentially aquatic. The eyes are always small, sometimes completely concealed beneath the skin, but never furnished with eyelids; the legs are small and weak, sometimes only two in number, and terminated by rudimentary toes.


Fig. 68.—Axolotl (*Siredon pisciforme*).

**Divisions.**—These singular animals, which are generally of small size, are divisible into two families, the *Proteidæ* and the *Sirenidæ*. The former have a compressed tail, large branchiæ, and four legs. Of these the best known is the *Proteus*, or *Hypochthon anguinus*, an extraordinary creature which is only found in the subterranean waters of some caves in the south of Europe (Carinthia and some other parts of the Austrian dominions). It is about a foot long, and sometimes nearly three quarters of an inch in diameter. It is of a pale flesh colour, or perfectly white, with the exception of the three pairs of branchial tufts, which are of a fine bright crimson; the body is cylindrical, and a good deal longer than the tail, which is broad, and much compressed. The legs are very weak, and the anterior pair terminate in three toes, the posterior in two. Although apparently a weak and sluggish animal the Proteus swims with considerable ease, with a leech-like undulation of the body, and like the *Lepidosiren*, it is said to bury itself in the mud at the bottom of its place of abode when the water happens to dry up.

Several species of this group are found in different parts of America; of these, one of the most remarkable is the Axolotl (*Siredon pisciforme*, Fig. 68), which inhabits the lake surrounding the city of Mexico, where it attains a length of ten or fifteen inches, and is esteemed a great luxury. At the time of the invasion of Mexico by Cortez, it was so plentiful in the lake that he is said to have fed his army upon it for some time; and Mr. Bullock, in his account of his residence in Mexico, states he saw it in thousands exposed for sale in one of the markets. The Axolotl is of a brown or grayish colour, spotted with black; the fore feet have four and the hind ones five toes; on each side of the neck there is a very large aperture, within which are branchial arches; but the projecting branched gills are attached to the opercula, or flaps, which close these orifices. The largest species appear to belong to the genus *Menobranchus*, of which one, the *M. lateralis*, which is found in the great North American lakes, attains a length of from two to three feet.

The *Sirenidæ* have only the two anterior legs; the body is elongated, and somewhat cylindrical, and the branchial tufts small. They have no operculum.

The best known species is the *Siren lacertina*, which inhabits the marshy rice-grounds of Carolina. It is of an eel-like form, and occasionally measures as much as three feet in length. The feet are small, and furnished with four toes, and the tail is compressed so as to form a sort of blunt fin. The *Siren lacertina* generally keeps in the mud and muddy water of the rice swamps, but is said occasionally to come upon land; it feeds upon worms and insects. Its original discoverer, Dr. Garden, who furnished Linnæus with specimens, accompanied them with some wonderful stories relating to its supposed habits. He stated that the *Siren* fed habitually on serpents, and that it had a sort of singing voice. From the latter circumstance Linnæus gave the name of Siren to the genus. Dr. Garden's statements have, however, been denied

by subsequent observers. Several smaller species are also found in different parts of the United States.

## Order IV.—Urodela.

**General Characters.**—The *Urodela*, in the general form of the body, frequently present a close resemblance to the Lizards, with which they were arranged by Linnæus and the older naturalists. They have a persistent tail, four limbs, which are sometimes very small, and occasionally the toes are furnished with claws. There are no external branchiæ, and the lungs are well developed; but in a few species there is a branchial aperture on each side of the neck, within which are the branchial arches, with their laminæ. The skin is either quite smooth or covered with warty prominences; it is usually furnished with numerous glands, which secrete an acrid, viscid fluid, and this has no doubt obtained for these animals the reputation for venom which many of them enjoy.

**Divisions.**—The Urodela form two great families. In the *Amphiumidæ* the limbs are of very small size; the neck has usually a branchial aperture on each side; and the eyes are minute and destitute of eyelids. These animals are generally of large size, the *Amphiuma tridactylum* attaining a length of three feet. Like the Sirenidæ, which they a good deal resemble in form, they are particularly partial to the mud of shallow waters. Most of them inhabit the United States of America.

The *Salamandridæ*, the only family of tailed Batrachia of which examples occur in our own country, is distinguished from the preceding family by the total absence of all traces of a branchial apparatus after the animals have attained their mature form, and also by the structure of the eyes, which are very prominent, and protected by eyelids.

This family is divisible into two very distinct groups or sub-families—namely, the *Tritons*, or Aquatic Salamanders, in which the tail is much compressed, and which frequently visit the water; their reproduction is oviparous, their eggs producing tadpole-like larvæ (Fig. 7), which gradually acquire the form of their parents, after swimming about for some time in the water, respiring by means of gills;—and the *Salamandræ*, or Land Salamanders, which have a cylindrical tail, and live on land in damp places, producing their young alive.

These divisions into terrestrial and aquatic species must not, however, be received in the strictest sense, as it appears, from the observations of Mr. Higginbottom upon our British Tritons, that these little animals really pass a great part of their time on land, and only visit the water during the breeding season. Mr. Higginbottom also states that the Tritons do not breed until they are fully three years old, and that the interval between their quitting the tadpole state, and retiring to the water for the purpose of breeding, is entirely spent on the ground. During this period, the young Tritons conceal themselves for the winter in solitary holes, often at a considerable depth in the ground; but the full-grown ones frequently collect together into a mass as large as a cricket-ball, and thus hybernate in company. At the approach of the breeding-season, which commences in March or April, the Tritons begin to acquire peculiar appendages, consisting principally of a fin-like crest running along the back and tail (Fig. 69), and some similar membranous appendages to the toes. When in the water they are exceedingly voracious, devouring almost all small aquatic



Fig. 69.—Triton.

animals, and not even sparing the Tadpoles of their own species. These are generally excluded about the month of June or July; and in the course of July or August the old Tritons quit the water, and again betake themselves to a terrestrial existence, whilst the Tadpoles, according to Mr. Higginbottom, remain for the most part without much change until the following spring, when they acquire legs, and are enabled to quit the water.

The species of Triton are very difficult to distinguish, as it appears that the characters of the same species vary greatly in accordance with sex and age—the crests and other appendages which make their appearance during the breeding season, having been particularly fertile sources of confusion. It appears, however, that we possess at least two distinct species, of which the larger, *Triton palustris*, measures, when full-grown, about six inches in length; whilst the smaller and commoner one, *T. aquaticus*, is only a little more than half that length. Both these species may be found commonly in ponds and ditches during the spring and summer months; the former is of a very dark brown above, with the sides mottled with white, and bright orange beneath, spotted with black. The colours of the smaller species are somewhat similar to those of the preceding, but are generally paler. Their tenacity of life is most wonderful; they may be mutilated in various ways, and will reproduce the lost members, as proved by the experiments of Bonnet and Spallanzani. According to the testimony of other observers, moreover, they may be frozen hard in the centre of a lump of ice, and recover their former activity as soon as they are thawed, even although they may have been in this close prison for some time.

When depositing their ova they inclose them very carefully in the leaves of aquatic plants, apparently in order to prevent the too free access of the water, which would cause the young to be developed too rapidly, and no doubt lead to their destruction.

The terrestrial species, or True Salamanders, have a rounded tail; and the young, instead of being developed in the water, are retained within an enlarged part of the oviduct, where they pass through the first part of their metamorphoses in an albuminous fluid. The Salamanders have a large gland behind the ear, which secretes a yellow matter; and small glands of a similar nature are scattered through the skin. The matter thus secreted is so abundant, that it was long a vulgar superstition that the Salamander, if put upon a fire, immediately discharged a quantity of water, sufficient to put the fire out; and many of these unfortunate Amphibia have no doubt been sacrificed in consequence of this belief. The Salamanders are generally of small size; none are found in this country, but several occur on the continent. They rarely exceed six inches in length.

## Order V.—Anura.

**General Characters.**—The general form of the animals included in this order, of which the well-known Frog may be taken as the type, is shorter and broader than that of any of the preceding groups, and the tail is entirely wanting. The head is broad, and the opening of the mouth very large. The limbs are of unequal length, the hinder pair being usually much longer than the anterior, supplied with powerful muscles, and fitted to enable the animals to perform considerable springs. The skin is quite naked, smooth, and extremely dilatable; in many cases it is furnished with a great number of glands, which secrete an acrid liquid.

The organs of the senses always exhibit a much greater degree of perfection than in the preceding groups ; the eyes are almost always of very large size, prominent, but retractile, and furnished with a pair of eyelids, of which the lower one is large enough to cover nearly the whole of the eye. The external ear is situated immediately behind the eye, and the internal portions of the auditory organ present a much greater perfection of organization than in any of the preceding vertebrata.

The upper jaw is usually armed with small, hooked teeth, and similar teeth are occasionally distributed in the lower jaw and palatine bone. The tongue is sometimes wanting, but is generally of large size, filling up nearly the whole space between the two sides of the lower jaw. It is usually fixed to the front of the mouth, so that its hinder part is quite free, and can be pushed out of the mouth to a considerable extent, and employed in the capture of prey.

The fore legs are usually terminated by four free toes, which are of nearly equal length ; the hind legs generally have five toes, more or less united by a membrane, and of unequal length, the innermost being by far the shortest, and the fourth usually the longest.

The spinal column of the Anura is very short, consisting, as a general rule, only of eight vertebræ ; it is terminated posteriorly by a long slender bone, which runs down the middle of the elongated opening of the pelvis ; the latter is composed of two very long parallel bones, which lie in the same direction as the axis of the spine. The thighs are articulated at the extremity of this pelvis.

The habits of these animals are very various. Many of them live habitually in the water, whilst others only visit that element for the purpose of depositing their ova, which give origin to tailed Tadpoles, the development of which has already been described (page 86). Of the species which only visit the water occasionally in this manner, some live constantly on the ground in moist places, or hide themselves under stones, and come out in search of food generally in the evening, whilst others pursue their insect prey upon the trees and bushes, the extremities of their toes being furnished with adhesive organs, which enable them to climb about with great ease and security.

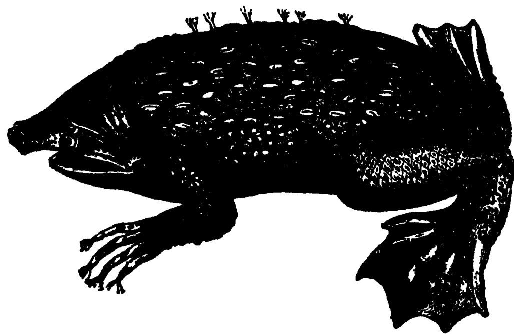


Fig. 70.—Surinam Toad (*Pipa Americana*).

**Divisions.**—This order, including the well-known Frogs and Toads, is divisible into three distinct and well-marked families. Of these, the *Pipidæ* are distinguished by the absence of the tongue ; the tympanum of the ear is concealed, the head is triangular, and the small eyes are placed low down towards the mouth. The body is broad and thick, and the hind legs exceedingly large and powerful, the toes being completely united by an ample membrane.

In the typical genus *Pipa* the teeth are wanting, whilst in *Dactylethra*, which is

also distinguished by having hoof-like claws on some of the toes of the hind feet, the upper jaw is armed with small pointed teeth.

The *Pipa americana*, or Surinam Toad (Fig. 70), belonging to this family has long been known as affording an example of a most remarkable and anomalous mode of reproduction. At the breeding season the back of the female exhibits a number of singular pits, each of which receives an egg, and the young animal, which, as usual, makes its first appearance in the form of a tadpole, undergoes its changes in this confined space, and emerges at once a perfect Toad. These facts have been known for many years, and for a long time it was supposed that the eggs (which are completely inclosed in the dorsal cells) were produced immediately in the place where they were found without going through the process usual amongst the other Anura. It has been found, however, that the *Pipa* does not differ from its fellows in this respect; but the mode in which the ova reach their destination certainly affords a curious example of instinct. The female deposits her eggs at the margin of the water, but the male, instead of merely impregnating them, and leaving them to their fate, takes the trouble to collect the whole mass of eggs and deposit them upon the back of his partner, where they are pressed into the open cells, which are afterwards closed with a sort of lid. The development of the embryo then takes place in these cells in exactly the same way as with the free larvæ of the other Batrachia. The Surinam Toad is commonly found in the dark corners of houses in Guiana and Surinam; it is, perhaps, one of the ugliest of the Toads; but notwithstanding its disgusting appearance it is eaten by the natives.

The *Bufonidæ*, or Toads, are always provided with a well-developed tongue, a character which serves to distinguish them at once from the preceding family. The body in these animals is thick and heavy, and the skin usually covered with glandular warts, from which an acrid juice exudes. The hind legs are but little longer than the others, and the animals are consequently unable to perform those great springs which are characteristic of the following family. But the most important distinction between these animals and the Frogs consists in the absence of the teeth in the Toads, the jaws being rather sharp at the edge, but quite unarmed.

The Toads are generally regarded with but little favour; and there is certainly not much in their appearance to recommend them. They generally come abroad in search of food in the dusk of the evening, when they may often be seen in gardens, woods, and lanes.

The Toads generally live out of the water, but visit that element during the breeding season, which is in March or April; during winter they lie in a torpid state, concealed in holes or under stones. They produce an immense number of eggs, which, instead of being inclosed in a mass of gelatinous matter as in the Frogs, are united into long strings inclosed in a similar substance. Of these strings or necklaces of eggs there are generally two, which the male draws out of the body of the female with his hind feet.

We have two species of Toads in this country—the common Toad (*Bufo vulgaris*, Fig. 71), and the Natter-jack (*B. calamita*). Several other species are found on the continent of Europe, amongst which the most remarkable in its habits is perhaps the species called the Accoucheur Toad (*B. obstetricans*), of which the male not only assists the female in the exclusion of the eggs, but attaches them afterwards to his own hind legs, where the young are developed until they arrive at the tadpole state, when the male visits the water, and the young animals escape. This species is very common in the vicinity of Paris.

Our common Toad feeds upon insects and worms of every kind; but it will not eat anything that is not living. When about to feed, it remains motionless, with its eyes fixed intently upon its intended prey, and remains in this position until the insect moves, when the tongue is instantly darted out of the mouth with the rapidity of lightning, and the victim rarely escapes being drawn back with it into the mouth. Mr. Bell states that when the prey is taken it is slightly pressed by the margins of the jaws; but as this seldom kills it, unless it be a soft tender larva, it is generally swallowed alive; and he adds that he has often seen the muscles of the Toad's sides twitching in a most singular manner from the tickling movements of a beetle that had been introduced alive into the stomach.



Fig. 71.—Toad (*Bufo vulgaris*).

There are probably few harmless animals that have suffered more from a false charge of venom than the Toad. Whether it be from the ugliness of the creature, or from some other cause, the Toad appears to be regarded as venomous by the popular mind of almost all countries, and the poison is said sometimes to reside in the saliva, sometimes in the bite, and sometimes in the liquid exuded from the skin. The last-mentioned matter appears really to be sufficiently acrid to produce painful effects if applied to a very tender or wounded surface; and it is said that dogs which have carried a Toad in their mouths for a distance, have been observed to be affected with a slight swelling of the lips, which, however, soon goes off, without any dangerous consequences.

It is well known that the Toad can live for a long time without food, and even with a very small supply of air; but the instances commonly related of these creatures being found imbedded in solid stone, or in the heart of the trunk of a tree, with no possible communication with the external world, must be regarded as arising from errors of observation. This is, however, a very curious subject; and much probably remains to be ascertained before we can satisfactorily account for the facts which have given rise to the common opinion. There can be no doubt, in fact, that Toads have been found in situations which rendered their obtaining food apparently an impossibility, whilst their supplies of air and moisture must have been very small; but we are not, therefore, prepared to admit, with some writers, that the animals were really inclosed hermetically in their prison. With Mr. Bell, we may say, "to believe that a Toad, inclosed within a mass of clay, or other similar substance, shall exist wholly without air or food, for hundreds of years, and at length be liberated alive, and capable of crawling, on the breaking up of the matrix, now become a solid rock, is certainly a demand upon our credulity which few would be ready to answer."

The *Ranidæ*, or Frogs, of which the Common Frog (*Rana temporaria*, Fig. 72) is a well-known example, have the body of a lighter and more elegant form than the Toads, and the hind legs are much longer, exceedingly muscular, and fitted for the performance of considerable leaps. The upper jaw is always armed with teeth; the skin is usually smooth, but in some cases is covered, as in the Toads, with glandular warts. In the structure of the tongue they resemble the Toads.

The Frogs, undoubtedly, form the highest group of the Batrachian class. They are active creatures, living on insects and worms, which may be divided into two sub-families, in accordance with important differences in their structure and mode of life.



Fig. 72.—Frog-(*Rana temporaria*).

The *Ranides*, or Frogs, which live upon the ground in the neighbourhood of standing water, and pass a considerable portion of their lives in the water, have their toes pointed, and those of the hinder feet united, almost to the tips, by a membrane.

The Common Frog is a very abundant and well known animal. It is constantly to be found hopping about in the neighbourhood of water, especially in damp evenings. It generally deposits its eggs in the water in the month of March; they are enveloped in a mass of gelatinous matter, within which the eggs are seen gradually to increase in size for a month or five weeks, at the end of which time the young tadpoles may be seen moving. When ready to enter upon their aquatic existence, they eat their way through the surrounding jelly, and thus escape. In the course of six or eight weeks the four legs are fully formed; the tail then gradually disappears, and the young Frog usually quits the water immediately. In this way they often suddenly make their appearance in prodigious numbers in particular spots, giving rise to the popular superstition of "Frog rains;" and in some cases it is said that the little creatures have been taken up and carried to a distance by high winds, to the great astonishment of the inhabitants of the districts in which they again descended.

The Common Frog is said to be five years in attaining its full size, and its life is supposed to extend to twelve or fifteen years. It passes the winter in a state of torpidity, either in holes in the earth, or buried in the mud at the bottom of ponds, without the possibility of feeding or breathing. The voice of the Frog is a peculiar hoarse cry, well known as *croaking*. In the males, there is a large sac on each side of the neck, which is inflated with air during the croaking, and probably serves to increase the sound.

The species of Frogs are very numerous, and distributed very generally over the globe; they are especially abundant in tropical countries. Their habits are generally very similar to those of the Common Frog. Of the European species, the most celebrated is the Edible Frog (*R. esculenta*), which is exceedingly common in standing water on the continent, although in England it appears to be rare. It is rather larger than the Common Frog; and its nocturnal croakings are said to be so exceedingly loud and disagreeable, that temporary dwellers in the neighbourhood of ponds frequented by it are often prevented from sleeping by its clamorous chorus. It is this species that is most approved of on the continent for culinary purposes.

Of the exotic species, one of the largest is the Bull-frog (*Rana pipiens*), which inhabits North America, and has received its name from the fact that its croak resembles the distant lowing of a bull. The body of this species measures sometimes as much as eight inches in length, without including the hind legs, which are large, and have the toes broadly webbed. This frog is said to confine itself exclusively to the small pools formed at the issue of springs, each of which, according to some observers, is taken possession of by a pair of Bull-frogs. The inhabitants believe that the frogs keep the water clean; consequently leave them without molestation, although they are often destructive to young ducks and goslings, which they swallow whole.

One of the most remarkable species is the Jakie (*Rana paradoxa*) of Guiana, in which the tadpole is of such large size, and possesses such an enormously developed tail, that the earlier observers described it as a frog which became converted into a fish.

The *Hylides*, or Tree-frogs, are distinguished from the preceding animals by their having the extremities of the toes dilated into small knobs (Fig. 6), which usually produce a sticky secretion, of the greatest service to the animal in its active arborea life. These animals are usually of a more elegant form and of brighter colours than the other Frogs, and they are particularly active during the day, thus in many respects presenting a great approach to the Lizards.

The Tree-frogs are active little creatures, pursuing their insect prey upon the trees and bushes; sometimes stealing cautiously towards their victims, and sometimes springing upon them with a sudden leap. In all these evolutions it is greatly assisted by the sticky palette-like terminations of its toes, and also by some glandular organs imbedded in the skin of the abdomen, which secrete a viscous fluid. The Tree-frogs have a very loud croak, and are observed to be particularly clamorous at the approach of rain. During the winter they bury themselves, like the other Frogs, in the mud at the bottom of pools. They breed in the spring, depositing their spawn in the water.

A curious property is attributed by Linnæus and the older writers to an American species of this group, the *Hyla tinctoria*. It was said that the natives of South America were in the habit of pulling out the feathers from young green parrots, and rubbing the blood of this frog upon the bare place; when it was believed that the feathers produced upon these spots would be of a yellow or red colour.

A singular species of this sub-family has recently been described by Dr. Weinland, of Berlin, under the name of *Notodelphys ovifera*. In this animal the back of the female is furnished with a large double sac under the skin, in which the eggs are retained, and the embryo developed as far as the production of the feet; the further progress of the young is not known. This species is from Venezuela.

## Class III.—Reptilia or Reptiles.

**General Characters.**—The true Reptiles, a group of animals generally regarded with but little favour by mankind, constitute the first class of the higher vertebrata, or of those in which a mechanism for aquatic respiration is never found. They differ from the Batrachia, which are very commonly included in the class of Reptiles, and with which they agree in the coldness of their blood, and, to a certain extent, in the character of their circulatory apparatus, not only in the important physiological point above mentioned, but also in several particulars of their anatomical structure, and especially in the mode of development of the embryo, in which they closely resemble the Birds.

The Reptiles in general, almost with the sole exception of the Tortoises, are of an elongated form, often nearly cylindrical, and they usually terminate posteriorly in a very long tail. The feet are very variably developed, but rarely suffice to support the animal in the manner of an ordinary quadruped; the belly, as a general rule, trailing along the ground when the animal is in motion. In a considerable number no traces of the limbs are to be found, and when they first make their appearance it is in such a rudimentary form that they can be of little or no use to their owner.

In all these animals the ossification of the skeleton is very complete, and in none of them does it present the cartilaginous state of that of many Fishes and some Batrachia. The true skull is always of comparatively small size, and the great bulk of the head is made of the bones of the jaws. The occipital bone always exhibits the vertebral form with great distinctness; it is furnished with a single articulating process, which, however, is sometimes divided into two parts by a narrow furrow: this fits into the cavity of the first cervical vertebræ. The floor of the cranium is formed by the sphenoid bone, and its upper surface principally by the parietals, which are usually amalgamated so as to form a single bony plate. The front of the cranial cavity is closed by the frontal bones, which are also frequently coalescent, and by the nasal bones.

The bones of the upper jaw and palate are always greatly developed; in some instances they are firmly fixed to the cranial bones, whilst in others they are moveable, and only attached to the skull by articulations. The lower jaw is of very complex structure, each half being composed of a variable number of pieces; in the Snakes, this number is four or five; whilst in the Lizards and Crocodiles each branch of the jaw consists of no less than six pieces. In the Snakes, the two branches of the lower jaw are united only by ligaments and muscles, so that they are capable of being separated to a considerable distance at the pleasure of the animal; but in the Lizards and Crocodiles the union is much closer, the bones being united by fibro-cartilage in the one case, and in the other by a suture; whilst in the Tortoises, the whole of the lower jaw is amalgamated into a single piece. The mode of articulation of the lower jaw varies greatly in the different orders, and will be referred to in the proper places.

The mouth in almost all Reptiles is armed with sharp hooked teeth, which are sometimes placed only on the jaws, but in some instances are distributed over the palatine bones and vomer. They are generally inserted into a furrow of the bone, to which they are attached only by flesh and sinews; but in the Crocodiles they are sunk separately into regular sockets in the jaws. In the Tortoises, again, no teeth exist, the edges of the jaws being simply armed with a horny covering, bearing no distant resemblance to the beak of a bird.

The vertebral column is rather variable in its structure. In a very few instances the bodies of the vertebræ exhibit a conical cavity at each end, like that existing in the vertebræ of Fishes; but in most cases one of the end-surfaces is more or less convex, and fits into a corresponding cavity in the body of the next vertebra. This structure is most developed in the Snakes, in which the bodies of the vertebræ articulate by a regular ball-and-socket joint. In the Tortoises, the two extremities of the vertebræ are flat, and united by a disc of fibro-cartilage. A striking osteological distinction between these animals and the Batrachia, consists in the constant presence of ribs in the former, these appendages to the vertebral column being always wanting in the latter class.

In the Reptiles the ribs generally extend backwards to the pelvis; they are always

well developed, and, in most cases, a greater or less proportion of them are attached to a well-developed sternum or breast-bone, which, in the Crocodiles, also runs back to the pelvis. In the Snakes the ribs are perfectly free at the extremity, and, from their great mobility, are important aids in the movements of these footless creatures; whilst in the Tortoises, on the contrary, these bones are immoveably fixed, and constitute a great portion of the bony case in which those animals are inclosed. The neck is generally short, and the cervical vertebræ are sometimes furnished with ribs: in the Tortoises, however, this portion of the vertebral column is of considerable length, and possesses great flexibility. The caudal portion is usually very long, and tapers gradually to a point; in many cases it more than equals the rest of the body in length.

In the development of the extremities these animals exhibit as great a diversity as the Batrachia. In the greater part of the Lizards and in the Crocodiles all the limbs are well developed. The feet are formed of freely moveable toes, which are usually terminated by strong claws; and the bony arches supporting these members are always of considerable size and firmness, so that the animal *walks* with facility, and is often able to perform considerable leaps. In some members of the group of Lizards, however, the extremities gradually diminish in size, still retaining their perfect form, but aiding little or nothing in the movements of the creature; in others the anterior pair disappear, and the posterior take the form of large scale-like organs, in which there is no external indication of any complexity of structure, although, except in the want of toes, the bones contained in them are identical with those of the more perfectly formed Reptiles; whilst in others, again, even these rudimentary limbs are absent. The latter structure prevails throughout the great group of Snakes, in which the only trace of the existence of the limbs consists in a pair of small bones suspended in the muscles near the vent in some species, which must be regarded as the analogues of the pelvic bones, the presence of which is sometimes indicated externally by a pair of horny spines projecting on each side of the anal opening. Of the perfectly developed feet several modifications occur. In general, the whole of the toes, which are usually five in number, are extended forwards from the extremity of the leg; but in the Chamæleons the toes are divided into two sets, one including two, the other three toes, forming a sort of grasping hand, which must be of the greatest service to these creatures in their arboreal residence. In the Crocodiles and some Tortoises the toes are distinctly recognizable externally, but united to a greater or less extent by membranes, in order to adapt these creatures for their aquatic habitation; and in other Tortoises the toes are completely concealed by a fleshy mass, which in the Land Tortoises is of a thickened and more or less cylindrical form, adapted for terrestrial progression, whilst in the Turtles it is much compressed and modified so as to form a broad and powerful fin-like organ.

In the clothing of the skin we find almost an equal diversity. In a small group of Lizards the skin is covered with free scales, lying over one another like tiles, in the same way as those of Fishes, and inclosed like these in peculiar dermal sacs; but in the majority the scaly covering has a very different arrangement. The scales are generally appendages of the true skin or corium, and are covered by the epidermis, a delicate horny pellicle, which is cast off periodically. In the Crocodiles and Tortoises they become converted into bony plates, which in the former are immersed in the corium, whilst in the latter they become united with the bones of the internal skeleton to form the well-known bony cases which serve as such an admirable protection for those sluggish creatures. In these also the epidermis becomes permanent, and forms thick, horny plates of regular forms, covering the bony skeleton.

With the exception of a few Tortoises, all Reptiles are carnivorous animals, feeding entirely upon living prey. Their teeth, however, are never constructed for the division of the flesh of their victims, and they are consequently compelled to swallow them whole. For this purpose the œsophagus is usually very wide, and capable of great dilatation, many of the Snakes actually being capable of swallowing animals of considerably greater bulk than themselves. The tongue is sometimes closely attached to the bottom of the mouth; but in most Reptiles it is free, elongated, and bifid, terminating,

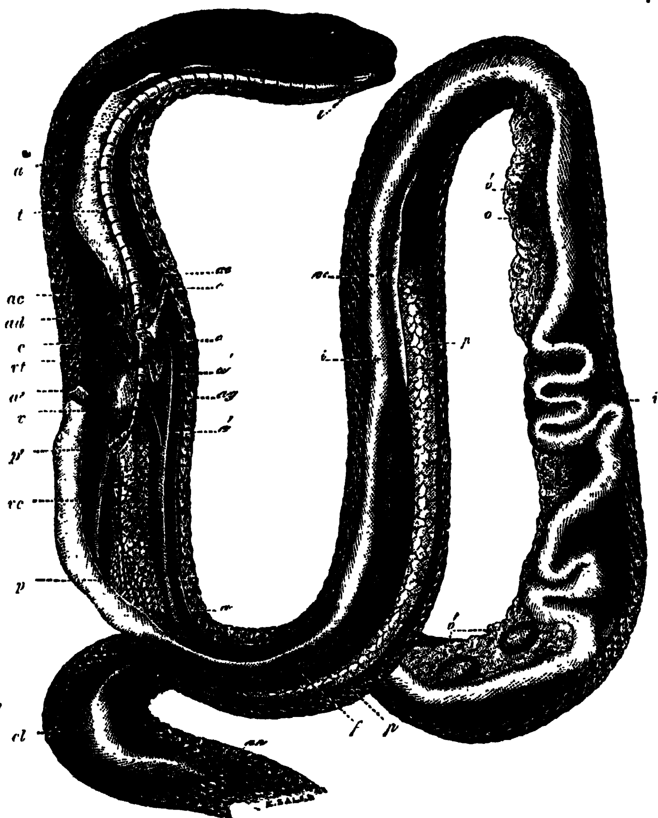


Fig. 73.—Anatomy of a Snake (*Coluber natrix*).
*l*, tongue and glottis; *œ*, œsophagus, divided at *a'* to show the heart, &c.; *i*, stomach; *i'*, intestine; *cl*, cloaca; *an*, anus; *f*, liver; *o*, ovary; *o'*, eggs; *t*, trachea; *p*, principal lung; *p'*, undeveloped lung; *vt*, ventricle; *c*, left auricle; *c'*, right auricle; *ag*, left aortic arch; *ad*, right aortic arch; *a' a'*, ventral aorta; *ac*, carotid arteries; *v*, vena cava superior; *vc*, vena cava inferior.

in many, in a pair of nearly horny filaments, which are inclosed in a sheath, and can be protruded and retracted at the pleasure of the animal. The intestine is usually of great width, but comparatively short; it terminates in a wide cloaca, into which the ducts

of the urinary and generative organs also generally open. The liver, pancreas, and spleen, are always present.

The anus opens in two very different directions in the Reptiles, and this character has been employed to divide the class into two great sections. In the Snakes and Lizards, the anal aperture is transverse, and usually closed by a sort of valve (see Fig. 75); whilst in the Crocodiles and Tortoises it opens in a longitudinal direction. These peculiarities in the anal aperture are accompanied by remarkable differences in the external generative organs of the male. In the former section there are two of these organs, which are contained in a cavity of the base of the tail behind the anus, whilst in the second the male organ is single, and lies within the cloaca. In the Lizards there is generally a transverse series of glandular organs placed immediately in front of the anal valve; and these are frequently continued upon the under side of the thighs. These glands open by a corresponding number of pores; and the presence or absence, and number, of these, especially of the femoral pores, often furnish valuable characters for the distinction of genera and species.

In the organs of circulation and respiration, the Reptiles exhibit a marked advance upon the Batrachia, although these organs are still far from exhibiting the same degree of perfection that they attain in the Birds and Mammalia. The heart consists essentially of four chambers, although in by far the majority of these animals the partition between the two ventricles is imperfect, so that, for all practical purposes, we may regard the ventricle as single. The consequence of this arrangement is, that the blood returning to the lungs, after exposure to the influence of the air, mingles with that brought back from the general system, and this mixed fluid is driven at once from the ventricle into the pulmonary as well as into the systemic arteries, so that only a portion of the venous blood passes through the lungs before being returned into the general circulation. In the Crocodiles, the partition between the two ventricles is complete; but in these, as well as in other Reptiles, a communication between the great pulmonary and systemic arteries is effected by the agency of the remains of the branchial arches of the embryo (Fig. 74). The aorta forms one, two, or three arches (Fig. 75), from the foremost of which the carotid arteries are sometimes given off. The aortæ afterwards unite in the middle of the body below the spinal column, forming a single great trunk, which runs down the body, and is called the abdominal aorta. The blood returning to the heart is collected in the venæ cavæ, of which the inferior forms a great trunk running up the body, and gives off a portal system of veins to the liver and kidneys (Fig. 75). The lymphatic system attains an extraordinary degree of development in this class, and possesses some regularly pulsating organs, or lymphatic hearts, which serve for the propulsion of the peculiar fluid contained in these vessels.

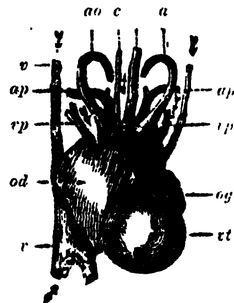



Fig. 74.—Heart and large vessels of the Crocodile.

v, vena cava, conveying venous blood from the system to the right auricle, *od*; *rt*, the ventricles, separated by an internal partition; *ap*, pulmonary arteries conveying venous blood from the right ventricle to the lungs; *rp*, pulmonary veins, running to the left auricle, *og*; *ao*, aorta rising from left ventricle, and conveying blood to the system; *a*, trunk rising from right ventricle, and carrying venous blood to the descending aorta; *c*, carotid arteries running to the head.

The respiration of these animals being always aerial, their respiratory organs, of course, take the form of *lungs*, and these are often of extraordinary size, in some

instances extending through the whole length of the ventral cavity, which is not divided by a diaphragm or transverse partition. In the more elongated forms, such as the Snakes and some Lizards, only one active lung is present, the other being reduced to a rudimentary condition or altogether wanting.

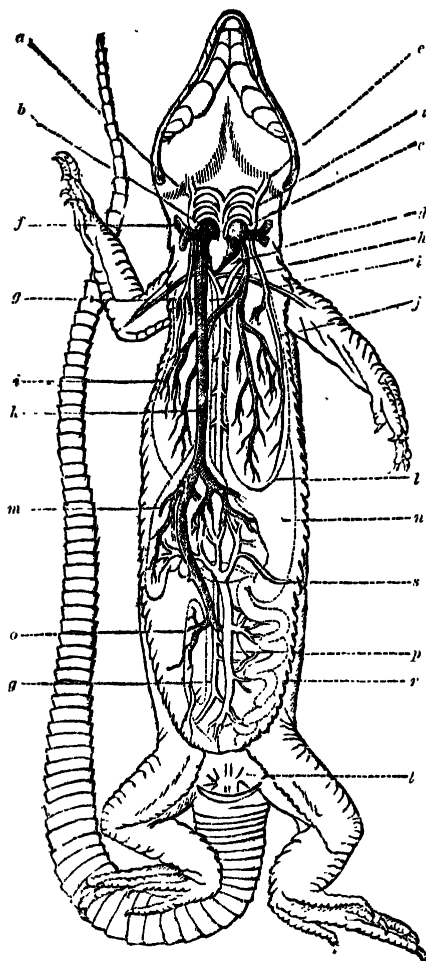



Fig. 75.—Circulation in a Lizard.

*a*, arches of aorta; *b*, left auricle; *c*, right auricle, *d*, ventricle; *e*, carotid artery; *f*, superior vena cava; *g*, abdominal aorta; *h*, pulmonary vein; *i*, brachial artery; *j*, pulmonary artery; *k*, inferior vena cava; *l*, lungs; *m*, liver and vena portæ; *n*, stomach, *o*, kidneys; *p*, vena portæ; *r*, intestines; *s*, artery of generative organs; *t*, anus.

The processes of respiration and circulation go on with far less activity in these animals than in the Birds and Mammalia, and their blood, like that of the lower Vertebrata, is cold, that is to say, its temperature is but little higher than that of the surrounding medium. The performance of all their functions partakes of this inactivity; their digestion goes on very slowly; and although they are capable of violent muscular exertion, and are often very agile in their movements, their general habits are sluggish.

In the general arrangement of the nervous system the Reptiles present a considerable resemblance to the Batrachia; but the brain, and especially the cerebral hemispheres, attain a much greater development in the higher species of the class. The cerebellum also exhibits a gradual development from the lowest to the highest forms.

The organs of the senses are generally possessed in a state of considerable perfection. The nasal cavities are of large size, and always open into the mouth; in the Crocodiles, this opening is placed very far back, and the palate is furnished with a velum, by which the aperture can be closed; the nostrils in these animals are also provided with valvular organs, which prevent the ingress of water. The eyes are usually small, sometimes, though rarely, concealed under the skin, generally furnished with eyelids. These protections to the visual organs are wanting in the Snakes, which have the front of

the moveable eye-ball covered with a transparent capsule, which is inserted under a fold of skin, like the glass of a watch in its frame. Between this capsule and the eye there is a space which is filled by the secretion of the lachrymal glands; the excess of this passes off through a duct into the nasal cavity. The eyes of most other Reptiles are furnished with a pair of eyelids, of which the upper one is usually very small and stiff, and the lower one alone is capable of being drawn up to cover the eye, which it does completely. In some cases this lower eyelid has a transparent space in the part corresponding with the pupil; in others, it is furnished with a peculiar bony plate. The most remarkable structure in this respect is presented by the Chamæleons, which have large, prominent, globular eyes, capable of very great and independent motion, but completely covered by a circular lid, in which there is only a small central hole corresponding with the pupil. All the Reptiles with eyelids also possess a nictitating membrane, which can often be drawn completely over the eye. The structure of the auditory organs is almost as complex as in any of the higher Vertebrata, but some of their component parts are often in a low state of development. The tympanum is sometimes exposed, sometimes covered by a fold of skin, or completely concealed under the skin; in the Crocodiles, there is a moveable valve, by which the tympanum can be concealed at pleasure.

All the Reptiles are truly oviparous animals, and by far the majority come under this denomination in its strictest sense; but the ova are generally retained within the body of the parent until the development of the embryo has proceeded a certain distance, and in a few cases, until the complete development of the young animal, which then breaks out of the egg whilst this is still inclosed in the oviduct. The species in which this phenomenon occurs are often called ovo-viviparous. The eggs of Reptiles are generally of large comparative size, and are furnished with a very large yelk; they are usually covered with a parchment-like shell, which occasionally contains a small portion of calcareous matter. The truly oviparous Reptiles generally deposit their eggs in warm, sandy places, where they leave them to be hatched by the heat of the sun; but the common opinion that they take no further care of the progeny, although correct in many instances, is certainly contradicted in others; for the Crocodiles and some Lizards are said to watch in the neighbourhood of the place where they have laid their eggs, so as to protect them from any threatened danger, and the gigantic Pythons have been seen, in the Tower and other menageries, to coil themselves round their mass of eggs in a conical form, closing the top with their heads. In the species which bring forth living young, the connection between these and the parent appears to be still closer; and, according to the testimony of some observers, the young of some of the poisonous snakes take refuge from impending danger by creeping down the throat of their mother.

In the development of the embryo, the Reptiles differ from the Fishes and Batrachia, and approach the higher classes of Vertebrated animals, especially in the formation of a peculiar membranous sac, the *amnios*, which completely envelopes the embryo; this structure does not occur in any of the lower Vertebrata. After the embryo has attained a considerable degree of development, a second membranous coat makes its appearance, of which we meet with no trace in the embryonic states of the lower vertebrata. This is the *allantois*, which forms a membranous sac, richly supplied with vessels, enveloping both the embryo and the amnios.

The Reptiles are essentially inhabitants of the warmer regions of the earth. In our northern countries but few species exist, and these pass a great portion of the year in a

state of torpidity, and only come abroad in the warm days of spring and summer; but in tropical regions the number of these creatures is surprising; Snakes and Lizards are to be encountered at every turn, and Crocodiles often swarm in the rivers and tanks. The size attained by these creatures in hot climates is also enormous—the Boas and Pythons of tropical America and Asia, and the Crocodiles and Alligators of the warmer parts of both continents often acquire dimensions which render them formidable even to man himself, and the virulence of the poisonous snakes of hot countries is so great, that their bite is frequently attended by fatal consequences.

**Divisions.**—The characters already given (p. 101), serve to divide the Reptiles into two great sections, each of which contains two orders. Of the two orders with a transverse anal aperture, which are also characterised by the absence of bony matter in the dermal system, the *Ophidia*, or Snakes, are distinguished by the constant want of limbs and eyelids; by their dilatable mouths, moveable facial bones, and by the total want of a sternum. In the Lizards or *Sauria*, the limbs are sometimes entirely absent, or present only in a rudimentary condition; but they are generally pretty well developed, four in number, and adapted for terrestrial or arboreal progression. Their mouths are not dilatable, and the bones of the upper jaw and face are firmly attached to the skull; the eyes are almost always provided with eyelids, and a portion of the ribs is always attached to a sternum.

In the second section, the anal aperture is either rounded or placed in a longitudinal direction, and the dermal skeleton acquires a bony consistence. Of the two orders of which it is composed, the *Loricata* or Crocodiles are distinguished by their lizard-like forms, their toothed jaws, and their skin covered with square bony plates imbedded in the corium; whilst in the Tortoises, or *Chelonia*, the bony plates of the dermal skeleton unite with the ribs and sternum to form a case for the protection of the soft parts of the animal, and the jaws are toothless and armed simply with a horny plate.

### Order I.—Ophidia.

**General Characters.**—Few animals appear to have been, in all ages, the objects of more general aversion than the creatures forming this order. Not to enter upon the question of possible theological grounds for this general disgust, we may take the statement in the book of Genesis, that "the serpent was more subtle than any other beast of the field," as a proof that at very early periods the stealthy creeping movements of these creatures had obtained for them the same reputation for cunning that they enjoy in the present day amongst the uninformed—a reputation which has caused them to become one of the most common emblems of deceit; whilst the poisonous properties possessed by some of them, having been extended in the popular mind to the whole group, cause them to be viewed by all with feelings of distrust and dread.

In the works of all the older naturalists, the popular notion of a snake as a reptile destitute of feet is adopted; and even in the "Règne Animal" of Cuvier, the distinction between the Serpents and Lizards reposes entirely upon the presence or absence of organs of locomotion. We have already seen, however, how very gradual is the series of steps in the development of the limbs of these animals; and this appears even to have been observed by Linnæus, who includes in his genus *Anguis*, all the species of snake-like lizards, whether furnished with rudimentary feet or totally destitute of those organs. The justice of this approximation cannot be doubted, but modern naturalists, instead of placing these animals, with Linnæus, amongst the Serpents, have removed them to the Lizards, with which they agree in most points of their organization. This

has necessitated the establishment of new characters for the distinction of these two groups, the old division, founded on the presence or absence of the limbs, being evidently untenable under any circumstances; and fortunately there is no difficulty in finding excellent characters for this purpose.

One of the principal distinctive characters of the Snakes consists in the peculiar structure of the jaws. The mouth in these animals is exceedingly dilatable; all the bones of the upper jaw and palate are freely moveable, with the exception of the intermaxillaries, which are firmly attached to the nasal bones; and the two branches of the lower jaw, each of which is composed of several pieces, are united in front by ligaments and muscles, which permit of their being separated to a considerable distance at the pleasure of the animal. But the principal cause of the immense extent to which the mouth of these creatures is capable of being dilated, consists in the mode in which the lower jaw is articulated to the head (Fig. 76). The mastoid bone, which in most Vertebrata forms a part of the skull, is here moveable and only attached to the skull by ligaments and muscles. It bears at its extremity a long, somewhat cylindrical bone, called the tympanic bone, to the opposite extremity of which the lower jaw is articulated; and as the tympanic bone usually takes an oblique direction, downwards and backwards, it often extends considerably behind the back of the skull, and thus enables the mouth to open beyond the head.



Fig. 76.—Skull of a poisonous Snake.

The jaws are always armed with hooked conical teeth, which serve only to hold the prey and assist in its progress down the throat; but the arrangement of these varies considerably in the different groups. In the innocuous snakes, the teeth all form solid cones, and are arranged in continuous rows round the whole of the upper and lower jaws, the palatine bones also bearing another double row of teeth. In many of the venomous species the maxillary bones are reduced to a rudimentary condition, and bear only a pair of long, acute, perforated teeth, which can be raised or depressed at will by the action of peculiar muscles. These, in fact, form a pair of tubes, communicating by ducts with the poison glands, and through which the venomous secretion of these glands is injected into the wounds made by the animal. The teeth of the palate and lower jaw are arranged in these snakes more or less after the same fashion as in the harmless species, but those of the true upper jaw are of course wanting, and this has given rise to an opinion that venomous snakes might be known by the want of maxillary teeth. This, however, is a mistake, as some of the most deadly species are furnished wiih a few teeth behind the poison fangs; and in some, which are suspected of poisonous properties, the upper jaw bears one or more large *furrowed* fangs towards its hinder part, its anterior portion being furnished with small solid teeth of the ordinary kind.

Snakes, like almost all other Reptiles, live entirely by the capture of living prey, and as their teeth are not adapted for the division of their food, they are of course compelled to swallow it whole. As their victims are often of considerable size, this operation is not unfrequently attended with difficulty; but the form and arrangement of the teeth and jaws are most admirably adapted for the peculiar exigencies of their mode of life. Dilating its mouth to the utmost, the Snake seizes upon one end of the dead body of its victim, and by the continual action of the jaws and teeth, gradually draws it into its throat, a process which, perhaps, might rather be described

as the gradual extension of the Snake over the body of its prey. The consumption of this mass of food takes place very slowly, and many Snakes, after a full meal, pass a month or six weeks in a state of torpidity, whilst the operation of digestion is going on.

The general form of these Reptiles is too well known to need description. They are totally destitute of limbs; the scapular arch and sternum are entirely wanting, and the only trace of the posterior extremities consists in a pair of small bones, representing the pelvis, and sometimes a second pair, corresponding with the hind limbs, which are found suspended in the muscles on each side of the vent in a few species. These bones occasionally bear a sort of horny claw, which projects slightly from the skin, on each side of the anus; but these organs are usually so small, that they can be of but little use to the animal. Their movements are entirely effected by the agency of the very flexible vertebral column, and the exceedingly moveable ribs. The latter are excessively numerous, extending from the neck to the extremity of the belly, or even beyond this into the tail, and the animal, when gliding along the ground, may be considered to be walking upon the free extremities of the ribs, much in the same way that the Millepedes (*Juli*, vol. i. p. 330) progress by the action of their innumerable little legs.

The skin appears to be covered with scales and plates, from the existence of numerous scaly appendages of the corium; these, however, are completely covered by the epidermis, which embraces them closely, and follows all the irregularities of surface, so that when the epidermis is cast it presents, as it were, an exact mould of all the elevations and depressions which existed upon the animal. On the upper surface of the body these dermal appendages have the form of scales; on the head and belly they are usually converted into plates, or shields, of larger or smaller size, and either of a hexagonal or quadrangular figure. The peculiarities of these organs furnish valuable characters for the classification of these animals.

The eye, as already stated, is destitute of lids, and covered with a glassy capsule, within which the eye is capable of moving freely. The ears are not visible externally; the nostrils are placed on the snout, and often quite at its extremity, and the tongue is very long, thin, bifid, and protrusible. There is usually only a single large lung, situated on the left side of the body—that of the right side is generally quite rudimentary. The trachea is very long, and often cellular, so that the distinction between the trachea and the lung is sometimes difficult of recognition, and the hinder part of the long lung is frequently destitute of cells, forming a simple sac, which probably serves as a reservoir of air. The other internal organs are also much elongated, in accordance with the general form of the body, and the gall bladder is often separated from the liver by a considerable interval.

**Divisions.**—The classification of these Reptiles presents considerable difficulties, and scarcely any two authors are agreed as to the limits of the subordinate groups, or the order in which they should be arranged. The general arrangement here adopted is much the same as that given by Dr. Gray in his Catalogue of the Snakes in the British Museum. He divides the order Ophidia into two sub-orders, the *Viperine*, or essentially venomous Serpents, with weak jaws, of which the upper is entirely destitute of teeth, except the two large poison fangs, and the *Colubrine* Snakes, which are, for the most part, harmless, although the upper jaw, in many species, bears fangs, besides the ordinary solid, maxillary teeth.

## Sub-order I.—Viperina.

**General Characters.**—The Viperina, or Venomous Snakes *par excellence*, are distinguished from all others by the peculiar arrangement of the teeth in the upper jaw. The true maxillary bones are reduced to a very small size, capable of a great amount of motion, and bear a single pair of long curved fangs,* which can be laid flat in the mouth during repose, or erected when in action by the agency of peculiar muscles. These are the only teeth supported by the maxillary bones; they are perforated throughout by a slender canal, which communicates with a large gland situated in the head, behind and under the eyes. This secretes the venomous fluid, which passes through a duct to the base of the tooth, and thence through the canal in its interior, until it is injected into the wound made by the bite of the Serpent. Its propulsion is effected partly by the contraction of the proper walls of the gland, and partly by the pressure of the muscles of the jaws, which act upon it during their contraction (Fig. 77). The poison which is thus injected into the wound mixes with the blood, and is then carried into the circulation, when it speedily produces an injurious effect, giving rise to an altered condition of the blood, which, if the poison be present in sufficient quantity, quickly renders it incapable of supporting life. In fact, a bite from one of the large poisonous Snakes of tropical climates is generally fatal, even to man, if the animal be in a vigorous condition and provided with a good supply of poison; but a bite from a similar Snake, after it has nearly exhausted its venom by previous attacks, may give rise to little or no inconvenience. It is remarkable, also, that the effect of the poison of these creatures is very different with different animals; the cold-blooded species in general appear to be almost indifferent to its effects, whilst most warm-blooded animals soon expire when a sufficient quantity is injected into their veins. Various means of preventing the injurious effects of the bite of these reptiles have been proposed, and the natives of most countries in which they abound have their favourite antidotes for the wounds inflicted by them. The only means, however, upon which it appears that much reliance can be placed, are those directed to preventing the poison from getting into the circulation, and of these the principal consist in sucking the wound—either with a cupping-glass or with the mouth, which may be done without the least danger, the poison being quite innocuous when taken internally—cutting out the wounded part, or burning it with a hot iron or with caustic applications. All these remedies must, however, be adopted immediately after the wound has been received; if any time be allowed to elapse the most distressing symptoms make their appearance, and if these can be relieved by the administration of medicines, which, however, appears somewhat doubtful, the patient generally suffers for a long period from the effects of the bite.

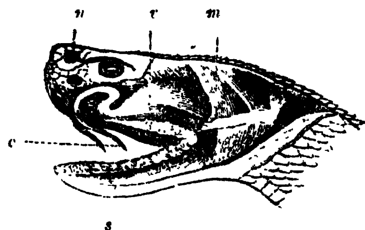


Fig. 77.—Head of Rattlesnake, with the skin removed.
n, nostril; r, poison-gland; c, fang; m, muscles of the jaws; s, salivary glands.

* Behind these there are some rudimentary teeth, which, however, are only developed when required to replace the fangs, if these have been destroyed by accident.

The remainder of the teeth of the Viperina, consisting of two rows in the palate and a row in each side of the lower jaw, are generally of small size and weak. The head is broad, and more or less triangular, broadest behind, so that the boundary between the head and the neck is very distinct; and the surface of the head is also generally scaly. All these Snakes, as far as we are aware, are ovo-viviparous, and, according to Cuvier, the term *Viper*, applied to the best-known species, is derived from this circumstance,—he regards it as a corruption of "vivipare."

**Divisions.**—The Viperine Snakes form two families,—the *Crotalidæ* or Rattlesnakes, and the *Viperidæ* or Vipers. The former family, which includes not only the true Rattlesnakes, so abundant in all parts of America, but also a considerable number of species distributed in other warm regions, is particularly distinguished by the presence of a deep pit on each side of the the nose, situated beneath, and usually a little behind, the nostril. This pit, the purpose of which is still unknown, is lined with small plates. The head is broad and flat, scaly on the crown, and furnished with small shields only on the sides and nose. The teeth are very small, but the poison-fangs are exceedingly large and powerful; and these Snakes must be regarded as the most dangerous of the order. The belly is covered with broad shields.

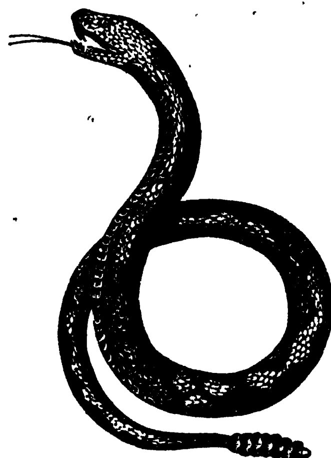


Fig. 78.—Rattlesnake (*Crotalus horridus*).

The best known examples of this family are the Rattlesnakes, which positively swarm in the forests of America, extending even as far north as Canada.

These Reptiles are distinguished from all other Snakes by the presence of a peculiar appendage at the extremity of the tail, composed of several horny pieces loosely articulated together, which produce a sort of rattling noise when the animal is in motion. The number of pieces of which this rattle is composed increases with the age of the animal, and it is said that a new one makes its appearance after every change of skin. The use of this appendage to the animal is not very apparent, and we cannot agree altogether with some of the older writers, who regard it as a kind dispensation of Providence to give a timely intimation to the traveller that he is in the vicinity of such a dangerous neighbour. It has been supposed that the Rattlesnake employs its rattle to startle the squirrels and other small animals, upon which it feeds, from their repose, and that these, being deprived of the power of making their escape, from the terror inspired by this unexpected proximity of their enemy, fall easy victims to its voracity, but this, like the accounts of the fascinating power exercised by the Rattlesnakes upon their prey, is scarcely borne out by facts. The Rattlesnakes are sluggish creatures, and rarely attack man, unless greatly provoked. The usual size of the common species (*Crotalus horridus*, Fig. 78) is from four to six feet, but specimens have been met with measuring eight feet in length. The bite of a large Rattlesnake is usually fatal, at least if the fangs penetrate to a sufficient depth to introduce the poison well into the circulation. Death is said sometimes

to ensue in less than two minutes after the infliction of the wound. A dog, bitten by a Rattlesnake of four feet long, has been known to die in less than a quarter of a minute. The Indians of America possess many supposed remedies for the bite of these terrible Snakes; but it seems probable that these, if useful, can only be advantageously applied to slight bites, which would not, of themselves, have proved fatal. Notwithstanding the formidable weapons with which these creatures are armed, the pigs in some parts of North America are said to destroy and feed upon them with avidity, and by some of the human inhabitants of that country, the Rattlesnake is regarded as by no means unpalatable food.

Those of the Crotalidæ in which the tail is destitute of a rattle, have that part of the body furnished with a sort of spine. These Reptiles often equal the Rattlesnakes in size and in the power of their venom, but many are, perhaps, still more dangerous, as they are exceedingly active animals, and are always ready to make use of the terrible weapons with which they are armed. The most dreaded serpent of the West Indian Islands, the *Craspedocephalus lanceolatus*, belongs to this group; it attains a length of six or seven feet, and inhabits the cane-fields, where it lives principally on the rats which abound in such situations, and when in pursuit of prey, or of any object of irritation, it frequently performs considerable springs. The Crotalidæ of the eastern hemisphere are confined to the Asiatic continent and islands.

The second family of this sub-order, the *Viperidæ*, is composed of the Vipers of the Old World, which are distinguished from the Crotalidæ by the absence of the pits in the sides of the face. The species of this family are entirely confined to the Old World, in the hot climates of which they are exceedingly abundant.

The common European Viper (*Pelias Berus*) is a well known example; it occurs in all countries of Europe, from Sweden and the north of Russia, to the shores of the Mediterranean. It is the only venomous Reptile found in Britain; but in some parts of this country it occurs in considerable abundance, generally inhabiting heaths, woods, and hedge banks, in dry, stony districts. It rarely exceeds two feet in length, and may be distinguished from the common Snake of our country—which, although perfectly harmless, often undergoes a fate intended for its poisonous relative—by the broad triangular head, and by the shortness of the tail, characters which it possesses in common with all the other Viperine Snakes. Its general colour is yellowish-brown or olive, the back marked with a double series of black spots, and the sides paler, and spotted with black. The spots of the back are often confluent, so as to form a series of transverse black bands, and other varieties sometimes occur, some of which have been described as distinct species. The poison of the Viper is by no means so powerful as that of some of the larger tropical species of venomous Serpents, but is still sufficiently so to produce exceedingly painful and injurious effects, especially in the warmer parts of Europe. Conscious of its formidable weapons, the Viper stands upon the defensive on the approach of a suspected enemy, unlike the common Snake, which always makes its escape as quickly as possible. With the body closely coiled up, and the neck and head raised and slightly thrown back, the Viper watches the object of its suspicion until the latter approaches within its reach, when the head is immediately darted upon it, a wound inflicted, and the poison injected, with the velocity of thought. Dogs are not unfrequently struck in this manner, and at a recent meeting of the Zoological Society, Mr. Yarrell stated, that when out shooting, he had seen two dogs bitten by Vipers. The symptoms produced were very distressing—the dogs' heads swelled up, and they became quite unable to proceed, and although they recovered from the immediate

effects of the bite, they were never afterwards of the least use. Two other species of this family are found in the south of Europe, and the islands of the Mediterranean.

Of the exotic species the most celebrated is the Cerastes or Horned Snake (*Cerastes Hasselquistii*), which is found abundantly in Egypt, and has acquired an historical celebrity from its having afforded Cleopatra the means of escaping from the disgrace of forming an appendage to the triumph of her Roman conqueror. The Cerastes is a small snake generally measuring from a foot to fifteen inches in length; although some specimens are more than two feet long. Above each eye in the male, there is a sort of horn-like process, with the point directed a little forwards, which, although it cannot be regarded as a weapon of any kind, yet adds greatly to the malignity of the creature's aspect. The Cerastes is found in great plenty in the dry sandy deserts of Egypt, Syria and Arabia, and probably in other parts of Asia and the north of Africa. It is said to be exceedingly active in its movements, springing to a distance of three feet or more when making its attack. According to Bruce, who has given a long account of its habits, many of the inhabitants of the countries infested by the Cerastes, handle these creatures with impunity, and even without their making the least attempt to bite; and in some cases, at any rate, this immunity is procured by constantly chewing certain roots and washing the body with a particular vegetable decoction. Bruce adds that the drugs were given to him, and that he several times "armed himself" to make the experiment, "but his heart always failed him when he came to the trial."

### SUB-ORDER II.—COLUBRINA.

**General Characters.**—The Colubrine Snakes are distinguished from those of the preceding sub-order by the greater strength of their jaws, and by having the maxillary bones much longer and armed with solid conical teeth, sometimes intermixed with fangs. The latter are, however, somewhat different in construction from those of the Viperina, they are simply grooved or slit down one side, and although the sides of this slit are often in close contact so as to form a canal in the interior of the tooth, they are never amalgamated as in the Viperine Snakes. The fangs of the Colubrine Snakes, moreover, are always immoveably fixed in the mouth, the different arrangement of the maxillary bones necessarily preventing those movements by which the Viperina are enabled to raise and depress their fangs at pleasure. The head generally tapers off gradually into the neck, and does not present the triangular form which prevails in the preceding sub-order, and the crown is frequently covered with shield-like plates.

**Divisions.**—The Colubrine Snakes may be divided into two great sections, according as the maxillary bones are armed only with solid teeth, or with these mixed with long, grooved fangs. The Snakes of the former group, which constitute the great majority of the sub-order, are perfectly innocuous; but the second section includes a considerable number of venomous species. The latter may be again divided into two groups; the *Venenosa*, including the undoubtedly venomous species which have the fangs placed at the anterior portion of the maxillary bones, with the solid teeth behind them; and the *Suspecta*, in which the fangs are situated at the back of the jaw behind the common teeth. The venomous species form two families, the *Elapidæ* and the *Hydrophidæ*.

The *Elapidæ* have a short, rounded head, covered with shields, and the nostrils are placed on the sides of the snout close to its apex. The body is rounded, and the tail round and tapering; the lower surface is covered with shields, which are usually single and transverse on the belly, but arranged in a double row under the tail. The poison-fangs

in these animals are much smaller than in the Viperine Snakes; but such is the virulence of their poison, that their bite is perhaps quite as dangerous as that of any other snake. The skin of the neck is very loose, and the ribs of that part of the body are capable of being extended and raised so as to dilate the skin into a sort of disc, which, from its resemblance to a hood, has obtained for these creatures the English name of Hooded Snakes, with which the Portuguese *Cobra di Capello*, by which they are perhaps better known, is exactly synonymous. The Indian species, *Naia tripudians*, to which the name of *Cobra di Capello* properly applies, is also known as the Spectacle Snake, from the existence of a curious mark upon the back of the neck exactly resembling a pair of spectacles in form. This Snake attains a length of three or four feet, or even more, and is certainly one of the most dangerous of the venomous serpents. Formidable as it is, however, a small mammiferous animal, the Mungoos (*Herpestes griseus*), does not fear to attack it and usually with success,—the Snake on being brought into the presence of its seemingly contemptible enemy, sometimes endeavouring to make its escape.

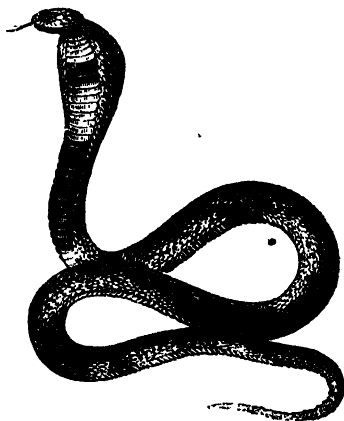


Fig. 79.—Egyptian Hooded Snake (*Naia Haje*).

The Mungoos, of course, often gets bitten in these encounters, but it is said to be acquainted with some particular herb which serves as an antidote to the poison of the Snake. The Hindoos assert that the root of the *Ophiorhiza Mungos* prevents the ill effects of the Cobra's bite. A very similar species, the *Haje* (*Naia Haje*, Fig. 79), is common in Egypt. Both these Snakes are commonly carried about for exhibition by the jugglers of their respective countries, the fangs being previously withdrawn. The Snake is taught to raise the fore part of the body in the attitude which it generally assumes when about to strike, and in this position it is made to move its head from side to side with a sort of dancing motion, to the sound of some musical instrument.

The *Hydrophidæ*, or Sea-snakes, are distinguished from the Snakes of the preceding family, with which they agree in the general arrangement of their teeth, by the compressed form of the short tail, which is converted into a vertical oar. The body is also compressed, and usually entirely covered with scales. The head is not distinctly separated from the neck, and is usually covered with shields; the nostrils are placed close together upon the upper part of the snout, and provided with valves to close them when the head is immersed in the water.

The Hydrophidæ are found exclusively in the seas of the warmer parts of the eastern hemisphere, on the coasts of India, and off the islands of the Indian and Pacific Oceans. Some of them occur as far south as the coasts of New Zealand and Australia. A few are found occasionally in salt water tanks and canals; but they usually confine themselves to the ocean, and rarely ascend beyond the mouths of rivers; in fact, they are said to be unable to live in fresh water. This is probably a mistake, as they are strictly air-breathing animals, and often visit the shore, where, in fact, they deposit their eggs. They are exceedingly venomous, and are regarded with great dread by the fishermen, in whose nets they are not unfrequently caught. They are, however,

eaten by the inhabitants of some of the countries on whose shores they occur. They rarely exceed four feet in length.

The second group of Colubrine Snakes, with both fangs and teeth in the maxillary bones (the *Suspecta*), includes a considerable number of species which are known to be harmless, whilst others are reputed venomous by the natives of the countries in which they occur, although, in most cases, it appears very doubtful whether they are really deserving of this reputation. In these Serpents the solid teeth are placed in front of the fangs, of which there are usually more than one on each side, which latter are grooved or split along the convex surface, although it does not appear that they communicate with internal poison glands. The head is usually covered with shield-like plates.

Of these Snakes there are three families. In the first, the *Homalopsidæ*, the nostrils are placed close together, and furnished with valves, as in the Hydrophidæ, which these Serpents also resemble in their aquatic habits, although they reside entirely in fresh water. They differ from the Hydrophidæ in the form of the tail, which is elongated, round, and tapering. These animals are especially abundant in the rivers and ponds of India and the islands of the Eastern Archipelago, where some of them are reputed venomous, but apparently without reason. They sometimes attain a considerable size.

The *Dipsadidæ* have a long, compressed, slender body, usually considerably narrower than the head, which is covered with shields, and the scales, or rather plates, which run along the back are considerably larger than the rest. Both jaws are sometimes furnished with fangs. The *Dendrophidæ* resemble the preceding in the form of their bodies, and in the possession of a row of large scales along the dorsal region; but the head is not wider than the body.

The perfectly harmless Colubrine Snakes, or those in which the large fangs are entirely wanting, may be divided into three families. In the first of these, the *Colubridæ*, or Snakes, of which the common Snake, or Ringed Snake (*Coluber natrix*, Fig. 80) of this country is a familiar example, the head is small, and somewhat triangular, but little thicker than the neck, and covered with shield-like plates; the nostrils are placed on the sides of the snout, and the eyes are small, and furnished with round pupils. The body is nearly cylindrical, and the tail long and tapering; the entire upper surface is covered with scales, the belly and throat with broad transverse plates, arranged in a single series, and the lower surface of the tail with two rows of similar plates. The mouth is large, and the jaws are furnished with numerous teeth, which are usually of nearly equal size; the intermaxillary bones are never armed with teeth. No traces of the hind limbs are to be discovered in the neighbourhood of the vent.



Fig. 80.—Common Snake (*Coluber natrix*).

The species of this family are excessively numerous, and their study is perhaps one of the most difficult problems in zoology. They are distributed in all parts of the globe, generally living on the ground, in damp woods and marshy places, where they prey to a great extent upon the Batrachia, which usually abound in such situations. Many of them are also inhabitants of the water; and most of those which dwell habitually upon the ground take to the water with great facility.

The common Snake (*Coluber natrix*) is tolerably abundant in Britain, and, indeed, throughout Europe; it frequents woods, moist bogs, and other sheltered situations, in the vicinity of water. It is an elegant creature, usually about three feet in length, of a pale olive colour, spotted with black on the sides, and whitish beneath. Immediately behind the head there is on each side of the neck a yellowish-white spot, which gives the animal the collared appearance which has led to its name of Ringed Snake; behind each of these pale spots is a semilunar black one. The common Snake preys upon almost any small animals that come in its way, such as insects, worms, small birds, mice, &c.; but its chief diet usually consists of frogs,—and in pursuit of the last-mentioned animals it has frequently been known to take the water. It deposits its eggs in warm, moist situations, frequently selecting hot-beds and dunghills, where the eggs are often found attached together, in the form of a necklace, to the number of fifteen or twenty. The young are said not to make their appearance until the following spring.

The common Snakes, like all the Reptiles inhabiting temperate and cold climates, pass the winter in a state of torpidity; a considerable number of them usually select some suitable retreat, where they remain closely coiled together until the return of mild weather recalls them to activity. It is generally supposed that Snakes change their epidermis annually, and Dr. Shaw states that this takes place in the spring, immediately after the animals have quitted their winter retreat. This, however, is not exactly the case, for the casting of the epidermis appears to take place at different intervals in different individuals; some observers stating that the change occurs twice in the year, whilst Mr. Bell says that he has known it take place four times in the course of the summer. Occasionally, and especially when excited or irritated, the Snake emits a most intolerable odour, although at other times it occasions no such annoyance; thus Gilbert White, in his "Natural History of Selborne," mentions the case of a tame Snake "which was in its person as sweet as any animal, while in good humour and unalarmed; but as soon as a stranger, or a dog or cat, came in, fell to hissing, and filled the room with such nauseous effluvia as rendered it hardly supportable." Cuvier states that the common Snake is eaten in some places.

Several other species belonging to this family are found in the southern countries of Europe. The largest of these is the *Coluber Elaphis*, which sometimes attains a length of upwards of six feet. It is found in Italy and the south of France; and Cuvier states that it is most probably the *Boa* of Pliny. Another remarkable species is the Æsculapian Snake (*C. Æsculapii*), which is found in great abundance in the neighbourhood of Rome, and is commonly represented by the ancients in their statues of Æsculapius.

Of the foreign species, we may refer to the *Tropidonoti* of North America, some of which live almost entirely in the water, where they swim with great rapidity in pursuit of frogs and fishes. None of them appear to exceed three feet in length, and they are all of a gentle disposition, suffering themselves to be handled without attempting to bite.

The aquatic species of this genus, *Tropidonotus*, frequently rest upon the branches of trees overhanging the water, doubtless looking out for prey. The *Heterodons*, which also inhabit the United States of America, have the snout pointed, and slightly turned up at the apex, and possess the singular power of dilating the back of the head and the neck when disturbed or irritated. Under these circumstances they usually coil themselves up, raise the head in a threatening attitude, and hiss in the manner of poisonous Snakes when about to strike, and they will even project the head at any object that may be extended towards them; but Dr. Holbrook states that he never could get them to open their mouths, or bite, by any amount of irritation. The older writers, however, attributed venomous properties to these harmless creatures, and Catesby describes and figures one of them as "having the like fangs of destruction as the Rattlesnake."

One of the most abundant of the North American Snakes is the Black Snake (*Coluber constrictor*), which is often six feet in length, and is entirely of a shining black colour. It is an exceedingly active animal, climbing trees with great facility, in search of the nests of birds, and, according to Catesby, pursuing rats into every crevice of the houses.

This Snake has a singular habit, which often produces ludicrous results. The inhabitants of the districts in which Rattlesnakes abound, usually take to flight the moment they catch sight of a serpent, without waiting to ascertain whether it is really one of these dreaded venomous Reptiles. The Black Snake, in such cases, prompted perhaps by a spirit of fun, immediately starts in pursuit of the fugitive, whom it generally soon overtakes, and, twining round his legs, brings him to the ground, but without doing him any other injury. The Black Snake often robs hen-roosts, and is said also to be in the habit of skimming the cream off the milk in dairies.

The second family of the fangless Colubrine Snakes is that of the *Boidæ*, including those large serpents of tropical countries, which, from their enormous size and strength, are almost as much to be dreaded as the venomous species. These Snakes are distinguished from the true Colubridæ by the presence of rudimentary hind limbs, consisting of a few small bones suspended in the muscles on each side of the vent, and terminated by a sort of horny claw, which is visible externally. The head in these Snakes is somewhat triangular, and slightly exceeds the neck in thickness, so that the distinction between these two regions is rather more perceptible than in the Colubridæ. The mouth is very wide, extending far beyond the eyes; both the jaws and the palatine bones are armed with teeth, as are also the intermaxillaries occasionally. The head is usually covered with shields, sometimes with scales; the throat is scaly, and the belly covered with transverse plates. The tail is usually rather short and prehensile—its lower surface is covered with a double series of shields.

The snakes belonging to this family are frequently of gigantic size; they are distributed pretty generally over the tropical parts of both continents. They may be divided into three groups, of which the first, the Pythons, including the largest species of the family, is distinguished by the possession of teeth in the intermaxillary bones. They possess a strong prehensile tail, with two rows of plates beneath, and the labial plates are deeply pitted. The Pythons are entirely confined to the Old World, and the largest species, forming the genus Python, are found only in India and the islands of the Eastern Archipelago. These snakes certainly attain a length of thirty feet; and an instance is on record of one of them measuring upwards of sixty feet in length, having

been destroyed in the act of coiling itself round a man who was lying asleep in a boat. They frequently ascend trees, and lie upon the branches in a position which enables them readily to drop upon any unfortunate animals that may pass their station; and both these and the Boas are said often to cling by the tail to some tree growing in the water, when they float upon the surface at full length, lying in wait for animals that may come to the water to drink. They prey upon animals of such bulk as would seem to render their swallowing them a matter of impossibility; according to some writers, they can destroy and gorge a buffalo; but specimens capable of such feats of voracity appear to be rarely met with, although there is no doubt that a good-sized *Python* will make away with a goat or calf. The victim is destroyed by powerful compression, effected by the snake coiling its body round it and then gradually tightening the folds. In this manner the body of the animal is reduced to a state fit for being swallowed, and this operation, which is effected in the way already described, usually takes a considerable



Fig. 81.—Boa Constrictor.

time. If we may believe the scattered notices of ancient authors, we may suppose that in earlier periods, when the human population of the earth was less numerous, these snakes attained still greater dimensions than at the present day. One instance of the occurrence of a gigantic snake on the northern coast of Africa, must be familiar to

most of our readers; we allude to the serpent which is said to have thrown the army of Regulus into confusion, killing and devouring several of his soldiers, and destroying others by squeezing them in its folds. The historian tells us, that this formidable snake was only destroyed at last by assailing it with the military engines usually employed in the siege of fortified places. This serpent is said to have measured upwards of one hundred and twenty feet; its skin was sent to Rome, where it was suspended in a temple, and remained for many years. It is, however, very doubtful whether implicit faith can be placed in this account, as the ancients generally appear to have had very exaggerated ideas of the size of the large serpents of Africa. Lucan is not content with attributing to them the power of destroying oxen, but also subjects even the elephant to their dominion!

In their habits the *Boas* exactly resemble the Pythons, from which they differ principally in the absence of the intermaxillary teeth. The majority of these Snakes are confined to South America and the adjacent islands, where some of them attain a length of upwards of thirty feet. The best known of these is perhaps the *Boa constrictor* (Fig. 81), whose name has generally been applied to all the large snakes.

A third group is formed by the genus *Eryx*, and one or two allied genera in which the head is rounded and not distinctly separated from the neck; the intermaxillary teeth are wanting, and the tail is short, obtuse, and not prehensile. These snakes, which are comparatively of small size, are found principally in India and some of the eastern islands. One or two species inhabit Turkey, Greece, and Egypt.

The Ophidia are concluded by the *Tortricidæ*, a small family of Serpents which are often included amongst the Boidæ, as, like them, they are furnished with spurs at the sides of the vent. They differ from these, however, in the small size of the mouth, which only extends backwards as far as the eyes; the bones of the upper jaw, also, are firmly attached to the head, and the branches of the lower jaw, although quite separate, are less extensible than in the other Snakes. These are small Snakes which live upon the ground in the tropical regions of both hemispheres. They are slow in their movements, and prey upon insects and other small animals. The Tortricidæ, in the structure of the head and mouth, appear to lead towards the next order, with the serpentiform species of which they were formerly confounded.

### ORDER II.—SAURIA.

**General Characters.**—As a general rule, the animals of this order are furnished with four well-developed legs, and may come under the popular denomination of *Lizards*; but in a considerable number these organs are wanting, and in some cases it is even doubtful whether these footless species should be referred to this or the preceding group. The only characters to which we can appeal in these cases are those furnished by the structure of the head and jaws. In the Sauria the bones of the upper jaw and face are firmly attached to the skull, so that they are quite incapable of any independent motion; and the mastoid and tympanic bones, which give support to the lower jaw, and which in the Serpents are moveably articulated to the skull, and thus enable the mouth to be dilated to a vast extent, are here united with the other bones of the head, so that the lower jaw, instead of a loose triple articulation, moves only from a single point. The branches of the lower jaw are firmly united in front by a suture, so that the lateral dilatation so remarkable in the Snakes is rendered impossible.

Both jaws are always armed with teeth; but these organs are generally confined to the bones of the jaws, and rarely occur upon the palate. Like those of the Snakes,

the teeth of the Saurian Reptiles are usually acutely conical and slightly hooked; but in some cases they are compressed, and occasionally dentated on the edges. The teeth are never inserted into separate sockets, but simply attached to the surface of the jaw. In some forms, however, the jaw is furnished with a furrow for the reception of the base of the teeth, which is bounded externally by a ridge; and each tooth not only stands upon a slight bony eminence, but is also attached by the external portion of its base to the inside of the ridge of the jaw.

The tongue exhibits two very distinct forms in these Reptiles. In some the tongue resembles that of the Ophidia, being long, slender, horny, bifid, and inclosed in a sheath, from which it can be protruded at pleasure, the front of the mouth being furnished with a notch for the passage of the tongue when the jaws are closed; whilst in others this organ is thick and fleshy, attached to the back of the mouth, destitute of a sheath, and only protrusible when the mouth is opened. This difference in the structure of the tongue has given rise to a division of the order into two great groups, the *Fissilinguia* or *Leptoglossa*, which exhibit the first modification, and the *Brevilinguia* or *Pachyglossa*, in which the second form prevails.

The eyes in the Lizards are almost always furnished with distinct eyelids, and the ear is generally visible externally. The structure of the skin and scales is usually the same as in the Snakes, and the head is almost always covered with shield-like plates.

The development of the extremities is very variable in this order, some species being as completely destitute of external limbs as any of the Snakes; whilst in others the members are well developed. They are generally four in number, and when present are always terminated by distinct toes, furnished with claws. An essential character, by which the Saurian skeleton is distinguished from that of the Ophidian Reptiles, consists in the presence of a sternum, to which some of the ribs are always attached; this bone increases in size in proportion to the development of the legs.

**Divisions.**—The immense number and great diversity of these animals render their arrangement a matter of considerable difficulty, and authors are by no means generally agreed as to the limits of the families, which are rather numerous.

The nearest approach to the preceding order is made by the *Typhlopidæ*, which, in fact, stand upon a sort of debateable ground, some writers claiming them for the Ophidia, whilst others refer them to the Lizards. They are small, worm-like creatures, of a nearly cylindrical form, quite destitute of limbs; the head is covered with shields, and the tail is very short, and rounded off at the end. The eyes are very small, and destitute of eyelids, sometimes rudimentary, and concealed under the skin; and there is no external ear. The bones of the upper jaw are firmly attached to the skull, and the snout projects considerably in front of the lower jaw, so that the opening of the mouth is situated in the under surface of the head. The surface of the skin is divided by a series of transverse and longitudinal furrows, into numerous square plates, each of which is furnished with a small horny scale. The dentition of these animals is remarkable, teeth existing only in one of the jaws; in some cases it is the upper, in others the lower, jaw that is thus armed. These singular Reptiles are found in considerable numbers in the warmer region of both hemispheres. A single species only is found in Europe. They live in holes in the ground and under stones, burying themselves sometimes to the depth of three or four feet, during the rainy season. They feed principally upon insects and worms, and are said to move with considerable swiftness.

Nearly allied to these are the *Amphisbænidæ*, which are also cylindrical, vermiform Reptiles, with the skin annulated and divided into square shields by transverse and longitudinal furrows. The head is of the same thickness as the neck; the tail rounded off and exceedingly short, so that the anus is almost at the extremity of the body; and the mouth is very small, and placed on the lower surface of the head. The tongue is thick, short, not sheathed, slightly notched at the end, and terminated by two smooth threads; the teeth are placed in a single row in both jaws, which are generally furnished with furrows for their reception, although in one genus (*Tropidophis*) the teeth grow upon the margin of the jaws. The eyes are very small, destitute of eyelids, and sometimes hidden under the skin; the ear is also covered by the skin. The majority are quite destitute of limbs; but in the genus *Chirotes* there are very small anterior legs, terminated by five toes. The only known species of this genus is the *C. lumbricoides*, a native of Mexico, which grows to a length of about eight inches. Like the Typhlopidæ, the Amphisbænidæ are found principally in tropical climates, and most of them are inhabitants of America. They live in the ground, and feed upon insects and worms.

We now come to the true Lizards, in which the limbs are almost always developed. These may be divided into two great sections, the *Leptoglossa* and the *Pachyglossa*, in accordance with the structure of the tongue (see page 117).

Of the Leptoglossa, distinguished by the bifid, sheathed, and protrusible tongue, several species still retain a considerable resemblance to the Ophidian Reptiles. This is particularly evident in the first family, the *Gymnophthalmidæ*, in which the body is exceedingly elongated and snake-like; the limbs are either rudimentary or altogether wanting; and the eyes are destitute of eyelids, and either covered by a transparent capsule, as in the Snakes, or completely concealed under the skin. The skin is covered with regular scales, imbedded in small sacs, and lying over each other like those of fishes. These imbricated scales are composed of a mixture of bony and horny matter, and they occur only in the Reptiles of this and the following family. The Gymnophthalmidæ are further distinguished from the two preceding families by the great width of the mouth, which extends considerably behind the eyes, and the free exposure of the ear.

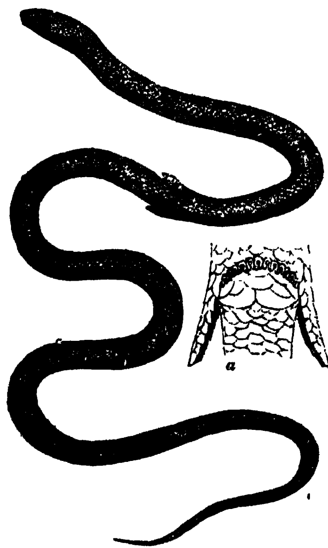



Fig. 82.—Pygopus lepidopodus. *a*, Vent and rudimentary legs.

The Reptiles of this family exhibit a great diversity in the development of the legs. In the *Gymnophthalmi*, there are four weak legs, terminated by a variable number of toes, the *Pygopi* (Fig. 82) and *Lialides* have the hinder limbs developed in the form of undivided scale-like organs, placed one on each side of the anus; whilst in the *Aprasiæ* the extremities are entirely deficient. The majority of the species are inhabitants of Australia, but

one or two are found in the east of Europe, and a single species occurs in the West Indies.

The *Scincidæ* resemble the preceding family in the structure of their scales, but may readily be distinguished by their well-formed eyes, furnished with distinct eyelids. The head, which is covered with shield-like plates, is of a somewhat triangular form, and a little pointed in front; the ears are exposed; the neck and body are nearly of the same thickness throughout, and but little thicker than the back of the head.

The difference in the development of the extremities is even greater in this family than in the Gymnopthalmidæ; some, like the common Slowworm (*Anguis fragilis*) of this country, are entirely destitute of limbs, and so perfectly snake-like in their form and appearance, that, until very recently, they were generally referred to the preceding order. Others, such as the Brazilian *Ophiodes*, have two rudimentary limbs close to the anus; in others, the four legs are developed, but to such a small extent that they would appear to be of little service to the animal; whilst others, again, are furnished with powerful limbs.

These Reptiles are generally of small size, and live, for the most part, in holes and under stones, in dry sandy places; they feed upon insects and worms. The only British species is the footless *Anguis fragilis*, or Slowworm, a small snake-like creature, which is vulgarly regarded as exceedingly venomous. So far from this being the case, however, it is one of the most harmless of Reptiles; and, instead of attempting to bite when seized by the tail, it will break off the captured portion and thus make its escape. This brittleness, which is possessed in a remarkable manner by many Lizards, is due to a peculiar action of the muscles, which is so violent in some species that they actually fall to pieces when handled.

The species of this family are exceedingly numerous, and generally distributed over the globe. One of the most noted species is the Skink (*Scincus officinalis*), a Lizard of about eight or nine inches in length, which inhabits Egypt, Nubia, and Arabia, runs with great swiftness, and when pursued, buries itself almost instantaneously in the sand. The ancients attributed extraordinary medicinal virtues to this animal, which was formerly salted and dried, and sold in the apothecaries' shops. It is now, however, going out of repute, even in the East. The West Indian Galliwasp (*Celestus occiduus*), a perfectly harmless Reptile, which is, for some reason, an object of the most intense dread with the inhabitants of the West Indies, also belongs to this family. A North American species, the *Plestiodon laticeps*, lives in holes of trees, often at a height of thirty or forty feet from the ground, where it frequently takes possession of the deserted nest of a Woodpecker. When disturbed, the Lizard puts out his head, which is very large, and of a bright red colour, in a most threatening manner; and when captured, his powerful jaws and strong teeth enable him to inflict a severe wound, although it is not venomous, as commonly supposed by the inhabitants of the United States.

The same variety in the development of the feet prevails in the next family, the *Chalcidæ*, which, however, are at once distinguishable from both the preceding groups by the nature of the dermal covering. Instead of the imbricated bony scales of the Skinks, the Chalcidæ are covered with scales of the ordinary reptilian character, arranged in regular transverse rows; the dorsal scales are usually strongly keeled, and the keels frequently produced behind so as to form spines; the sides are, in most cases, furnished with a fold of skin, covered with granular scales. The eyelids are always present, the ears generally exposed, and the tongue is short, fleshy, and notched

at the tip. The species of this family occur for the most part in Africa and America; a few are found in the warmer parts of the Asiatic continent; and a single species, the Scheltopusik (*Pseudopus Pallasii*), inhabits the south-eastern portion of Europe. The last-mentioned Lizard bears a considerable resemblance, in the form of the feet, to the *Pygopus lepidopodus*, figured on page 118. The Glass Snake of North America (*Ophisaurus ventralis*), which is common in the United States, is remarkable for the great facility with which it breaks; it is said that when touched with a stick it will immediately separate into several pieces. This, of course, can only apply to the tail, which is considerably longer than the body.

In the *Lacertidæ* the body is clothed with scales, and the head with large regular plates; the head is distinctly separated from the neck, which is never furnished with a pouch under the throat, or with any other appendages; the eyes are provided with a pair of moveable eyelids, and also usually with a nictitating membrane. The body is elongated, and generally of a somewhat cylindrical form, terminated posteriorly with a very long, tapering tail, which is often very much longer than the body. The feet are well developed, and generally furnished with five distinct toes of unequal length. The teeth are slightly curved, and inserted in a slight furrow of the jaw; they are hollow at the base, and are not very firmly attached to the bone.

These Lizards, which must be regarded as the types of the Sauria, are confined to the countries of the eastern hemisphere, over the whole of which they are pretty generally distributed. One species, the common Scaly Lizard (*Zootoca vivipara*), is found abundantly in this country. It frequents dry banks and sandy heaths, where it may be constantly seen basking in the sun in warm weather, and watching for its insect prey. It is excessively active and watchful, and disappears instantly on its apprehending any danger, generally making for some thick bush. Like the other species of the family it feeds upon insects of different kinds, apparently preferring flies, in the pursuit of which it displays great agility. The common lizard is viviparous.

Several other species inhabit the southern countries of Europe, and of these, one—the *Lacerta agilis* (Fig. 83)—has been taken in England. Another species, the Green Lizard (*L. viridis*), is common in Jersey. The most beautiful of the European species is the *Lacerta ocellata*, which occurs in Italy, Spain, and the south of France, and is also met with in Africa. This Lizard measures more than a foot in length, and is of a fine green colour, reticulated and spotted with black, and adorned with blue spots on the sides of the body.

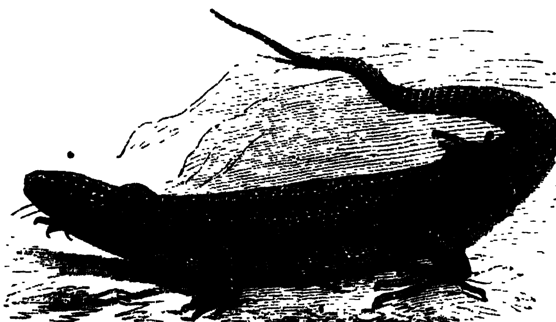


Fig. 83.—Lacerta agilis.

The Lacertidæ are represented in America by the *Ameividæ*, which resemble them in their general characters, but differ in having solid teeth firmly attached to the jaws,

which are furnished with a deep furrow for their reception. The spines of this family resemble their old-world relatives in habits. They live on the ground in woods and hedges, and feed principally upon insects, although they not unfrequently also capture small vertebrate animals.

Some of the Ameivas attain a large size, the Teguexin (*Teius Teguexin*), which inhabits Brazil and Guiana, measuring sometimes as much as six feet in length. It is a voracious animal, preying upon mice, frogs, and other small animals, and it is said occasionally to visit the poultry-yards, to feed on the chickens or eggs. Its flesh is highly esteemed in Brazil; it is said to be white, and not unlike that of a fowl in flavour. When pursued, the Teguexin does not allow itself to be taken without a struggle; it runs with great swiftness, and strikes such violent blows at the dogs with its tail that they do not readily venture to attack it. When brought to bay, it fights boldly, and inflicts severe bites upon anything that comes within its reach. The species of the genus *Ameiva* are elegant and inoffensive Lizards, which abound especially in the West Indies.

The *Varanidæ*, which form the last family of the slender-tongued Lizards, resemble the preceding families in the form of their bodies, and in the constant development of the limbs, but differ from them in having the head and belly covered with scales resembling those of the rest of the body, instead of the shield-like plates which form the clothing of those parts in the Lacertidæ and Ameividæ. The head is elongated, and the tongue, which is very long and distinctly bifid, like that of a snake, is received at the base in a membranous sheath. The tail is very long, usually compressed and keeled; and the feet large, and furnished with long toes, terminated by strong claws.

The species of this family are confined to the Old World, with the exception of a single species, the *Heloderma horridum*, or Caltetepon, which is an inhabitant of Mexico, and which is distinguished by the possession of furrowed fangs at the anterior portion of the jaws,—a structure which gives some support to the belief in its venomous properties entertained by the inhabitants of its native country. It differs so much from the other species of the family, that Dr. Gray has founded a separate family (the *Helodermidæ*) for its reception.

The best known species of the family are the Monitors, which inhabit the neighbourhood of rivers, where they are said to give notice of the presence of crocodiles by a sort of whistling noise, and this is probably the origin of the name *Monitor*, applied to the reptiles. A species of this genus, the *Monitor niloticus*, is common in Egypt, where it attains a length of five or six feet. This animal is said to devour the eggs of crocodiles; and it is probable some such opinion was entertained by

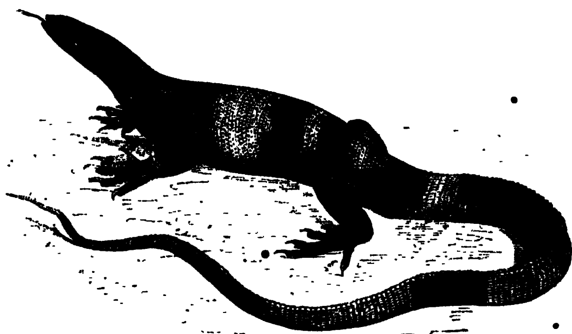
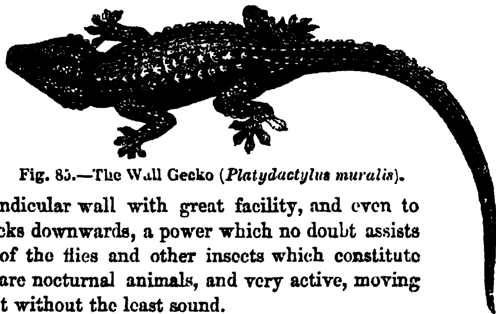


Fig. 84.—Hydrosaurus Bellii.

the ancient Egyptians, as the Monitor is frequently represented upon their monuments. Similar species inhabit the neighbourhood of water in various parts of the Old World. The *Hydrosaurus Bellii* (Fig. 84) occurs in Australia.

The other species of the family frequent dry sandy places. One species, the *Psammosaurus Scincus*, is common in the Egyptian deserts; it is supposed by some to be the true Skink of the ancients.

Of the *Pachyglossa*, or thick-tongued Lizards, the first family is that of the Geckos (*Geckotidæ*), a group including a great number of species distributed in all parts of the world. These Lizards are of a depressed form, with a distinct neck, and the whole upper surface of the body is covered with granular scales. The eyes are large and prominent, but furnished with no true eyelids; the pupil forms a perpendicular cleft. The ears are exposed, but small. The legs are short, and terminated by five nearly equal toes, which are usually destitute of claws, but which are furnished beneath with a peculiar apparatus for clinging, very similar in its action to that by which many insects are enabled to walk upon polished perpendicular surfaces. The lower part of each toe is dilated, forming a sort of disc, the inferior surface of which is composed of numerous transverse, notched laminæ, between which a sticky fluid exudes. By means of this apparatus the Geckos are enabled to run up a perpendicular wall with great facility, and even to cross a ceiling with their backs downwards, a power which no doubt assists them greatly in the capture of the flies and other insects which constitute their principal food. They are nocturnal animals, and very active, moving about with great rapidity, but without the least sound.


Fig. 85.—The Wall Gecko (*Platydactylus muralis*).

The Geckos occur in great abundance in warm climates. They are generally of a repulsive appearance, and this is no doubt the reason why many of the species are considered venomous by the inhabitants of the countries where they occur. Three species are found in the south of Europe, of which the best known is the Tarentola, or Wall Gecko (*Platydactylus muralis*), which inhabits all the countries bordering the Mediterranean. It receives its name from its habit of living in the holes of old walls.

The name Gecko applied to these Lizards is said to be an imitation of the sound produced by one of the species, the *Gecko verus*, or true Gecko, an inhabitant of India and the neighbouring countries. They do not all emit a similar sound, however, for the common species in the West Indies, *Thecadactylus lævis*, has received the name of the Croaking Lizard, from the singular noise it makes. Mr. Gosse states that this animal is to be seen and heard in every boiling-house in Jamaica, where it reposes during the day upon the rafters. It is universally regarded as venomous in the West Indies; but this, as Mr. Gosse hints, is undoubtedly due to its repulsive appearance.

The *Iguanidæ* constitute another exceedingly numerous family. They are frequently of considerable size; the head is usually broad and flattened, and frequently furnished with comb-like ridges, or membranous lobes, and similar appendages are usually continued along the back. The throat, also, is almost always furnished with mem-

branous expansions of some kind; these sometimes take the form of large, loose, inflatable sacs, which are often brilliantly coloured, and sometimes constitute large frills on the sides of the neck (Fig. 86). The eyes are always furnished with lids, which can be completely closed; the ears are freely exposed, and the tongue is short and thick, and free only at the tip.



Fig. 86.—Head of Chlamydosaurus Kingii.

The Iguanidæ are divisible into two great sections, upon characters derived from the teeth, and these also correspond with the geographical distribution of the species. Thus the American species, or the true *Iguanidæ*, have a deep furrow in all the jaws, and the teeth, which are often curiously flattened and toothed at the free edge, are attached to the inner surface of the jaw-bone. In the species inhabiting the Old World, on the contrary—composing the sub-family *Agamidæ*—the teeth always grow upon the edge of the jaw.

The common Iguana (*Iguana tuberculata*) which may be regarded as the type of the family, is a large Lizard, which attains a length of four or five feet, and is common in all the tropical parts of America. It is of a greenish colour, mottled with a brighter green, and banded with brown on the tail; along the back runs a comb-like crest, and the throat is furnished with a large membranous expansion, which is also denticulated in front. This Reptile is much sought after in the countries where it abounds, its flesh being regarded as a great delicacy, although it is said not to be particularly wholesome. It passes a great part of its existence in trees, and is commonly taken when resting on a branch, by slipping a noose over its head, its captor whistling to it while engaged in this operation. Its teeth have the crowns compressed and serrated, and it lives principally upon fruits and seeds. It is said to take the water freely, and to swim with facility.

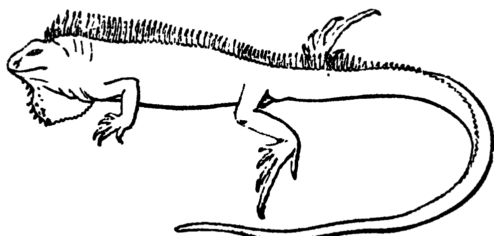


Fig. 87.—Iguana.

One of the most remarkable of the American species is the Basilisk (*Basiliscus Americanus*), which, although perfectly harmless, is certainly one of the most forbidding looking of Reptiles. It is found in South America, and occasionally attains a length of upwards of three feet. Instead of the comb-like dorsal ridge of the Iguana, the Basilisk is furnished with a broad membrane running down the back, and a second, still broader, on the upper surface of the tail, and these are supported by a series of bones, consisting of the elongated spinous processes of the dorsal

and caudal vertebræ, which give them exactly the appearance of long, perpendicular fins. The crown of the head is also furnished with a curious pointed, hood-like crest. This animal, like the Iguana, is principally an inhabitant of trees: it feeds on insects and other small animals, and is said to be quite at its ease in the water.

Many of the Iguanidæ, in fact, appear to be partially aquatic in their habits, and one species, the *Amblyrhynchus cristatus*, which is common on the Galapagos Islands, passes the greater part of its time in the sea. Mr. Darwin, the first naturalist who observed this Lizard, describes its habits in the following words:—"It lives exclusively on the rocky sea beaches, and is never found—at least I never saw one—even ten yards in-shore. It is a hideous-looking creature, of a dirty black colour, stupid, and sluggish in its movements. The usual length of a full-grown one is about a yard; but there are some even four feet long. I have seen a large one, which weighed twenty pounds. These Lizards are occasionally seen some hundred yards from the shore, swimming about; and Captain Collnett, in his voyage, says, 'they go out to sea in shoals to fish.' With respect to the object, I believe he is mistaken; but the fact, stated on such good authority, cannot be doubted. When in the water the animal swims with perfect ease and quickness, by a serpentine movement of its body and flattened tail,—the legs during this time being perfectly motionless and closely collapsed on its sides. A seaman on board sank one with a heavy weight attached to it, thinking thus to kill it directly; but when, an hour afterwards, he drew up the line, the Lizard was quite active. Their limbs and strong claws are admirably adapted for crawling over the rugged and fissured masses of lava which everywhere form the coast. In such situations, a group of six or seven of these hideous reptiles may oftentimes be seen on the black rocks, a few feet above the surf, basking in the sun with outstretched legs." Ugly as they are, these Lizards are quite harmless, their food consisting of sea-weed.

Many of the Iguanidæ are of the most brilliant green colour, with the large sac beneath the neck of a beautiful orange tint; when irritated or alarmed, however, they quickly change this gay livery for a more sombre colour, and many of them become perfectly black under these circumstances.

The *Agamides*, or Old World Iguanas, are principally inhabitants of the warmer regions of Asia and Australia, and the intervening islands; a few are found in the south of Australia, Van Diemen's Land, and New Zealand, and a few others in Africa, from Egypt to the Cape of Good Hope. In their general form, and in the character of their peculiar appendages, they closely resemble the American species; but some of them are particularly remarkable. One of these is the *Chlamydosaurus Kingii* (Fig. 86), which is not uncommon in the neighbourhood



Fig. 88.—Lophyrus tigrinus.

of Port Essington. The appearance of this Lizard is most extraordinary; it is furnished with a curious crenated membrane, forming a sort of frill or tippet round its neck, and covering its shoulders. Each side of this singular appendage is furnished with four cartilaginous plates, by means of which it can be folded up or extended, in the manner of a fan, at the pleasure of the animal. This Lizard measures about two feet in length; it is a bold animal, fighting fiercely when pursued, and always extending its broad ruff when in circumstances of irritation or danger.

A still more remarkable development of the dermal system is presented by the little flying Dragons of the East Indies, which are furnished with a broad membranous lobe on each side; this is supported by the six first false ribs, which are extended straight outwards from the vertebral column. By the movements of these bones the Dragons are enabled to stretch their broad lateral membranes, which thus form a sort of parachute to support them in long leaps from branch to branch. They are, however, quite

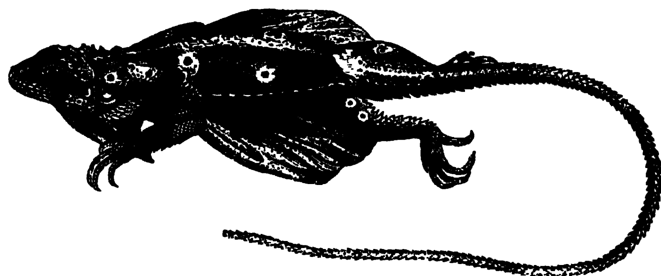


Fig. 89.—Dragon (*Draco volans*).

destitute of any power to strike the air, so that their flight is in fact nothing but a floating through the air. The flying Dragons of the older writers are fabulous creatures, and their descriptions are known to have been, in some instances, founded upon articles manufactured for the express purpose of taking in the too credulous naturalist.

Some other species of the Agamides are worthy of notice. Amongst these we may mention the *Stellio vulgaris*, a common Lizard in the Levant, and especially in Egypt, where its excrements were formerly collected, and used as a cosmetic. Cuvier states that the Mahometans destroy this animal wherever they see it, because, as they say, it insults them by bowing its head in imitation of their motions when engaged in prayer. A singular species of this group, from Australia, has been described by Dr. Gray under the name of *Moloch horridus*. The whole surface of this Lizard is covered with irregular plates and strong acute spines, and the upper surface of the head bears two very large spines. The larger conical spines are hollow, forming only a horny sheath, placed on a fleshy process of the exact form of the spine. Dr. Gray says that this Lizard is the most ferocious looking of any with which he is acquainted, the horns on the head, and the numerous spines on the body, giving it a most formidable aspect. The back of the neck is furnished with a large rounded protuberance, covered with granular spinous scales, and armed on each side with a long conical spine; this appendage greatly increases the singularity of the animal's appearance.

The last family of the recent Sauria is that of the *Chamæleontidæ*, including an animal which, with its property of changing its colour at pleasure, has probably been familiar to most of us, by hearsay, from our earliest years. This family, which includes only the single genus *Chamæleo*, containing about eighteen known species, all inhabitants of the Old World, is perhaps the most singular in the whole order of Lizards. The Chameleons are all small animals, with a curious pyramidal, and usually angular head, distinctly separated from the neck, a short, thick body, which gradually tapers from the region of the shoulders to the point of insertion of the hind legs, and a short prehensile tail. The mouth is very large; the teeth are firmly attached to the jaws; the ears are entirely concealed under the skin, and the eyes, which are very large and prominent, are closely covered by a circular lid, which is only perforated by a small round opening immediately in front of the pupil. The legs are rather long and slender; the feet are composed of five toes, which, however, are divided into two opposite bundles, and the toes of each bundle so united together by skin, that each foot may be described as forming a hand composed of a single broad finger and thumb. By means of these grasping organs, aided by their prehensile tails, the Chameleons climb about upon shrubs and trees in search of the insects which constitute their sole nourishment, but they exhibit none of that agility which renders many of the other small Lizards such interesting objects. All their motions, in fact, are very slow, and give the spectator the idea of the most painful caution; they are very sluggish, and sit for a long time motionless upon a branch, only occasionally giving a scarcely perceptible sign of life, by moving one of the eyes, which are capable of independent motion.



Fig. 90.—The Chameleon (*Chamælco Africanus*).

At first sight it would appear that a sluggish creature like this would have but little chance of capturing a sufficient number of the active denizens of the air, which constitute its only diet, to satisfy the necessities of its appetite; but on examination we find that the structure of the tongue of the chamæleon is most admirably adapted to assist in procuring food. This tongue is composed of a hollow tube, capable of extending itself with the rapidity of lightning to an enormous comparative length, it is terminated by a fleshy knob, which has a cup-like cavity in its anterior surface, and this is always induced with a viscid secretion. When the chamæleon has marked an insect for its prey, it immediately darts the tongue at it with the most astonishing rapidity, and rarely misses its aim, although the tongue is often protruded to more than twice the length of the whole body of the creature. The fly, or other insect, is of course drawn back with the tongue into the mouth. The difficulty of observing processes which are effected so instantaneously, coupled with the fact that the chamæleon can support a very prolonged abstinence without injury, led the ancients to the opinion that this animal was nourished by air alone; and this, which has frequently furnished the poet with similes, is still, to a certain extent, a matter of popular belief.

Another curious subject connected with the chamæleon, and which has also been much exaggerated, is its power of changing its colour. The variation in this respect appears to be that the animal under certain circumstances passes gradually from its natural pale gray colour, through pale green to yellow and dingy red; and if the exciting cause of the change be continued, it will finally become dusky violet, or nearly black. The cause of this phenomenon is described as follows:—Beneath the transparent epidermis there is a great quantity of minute soft granules, which bear the different colours; these are more or less extended, according to the quantity of blood that reaches them, and the change of colour is thus effected.

The common chamæleon (*Chamæleo Africanus*, Fig. 90), occurs in all the northern parts of Africa, and also in India; it has become naturalized in some parts of the south of Europe. Several other species are found in different parts of Africa.

The Chamæleontidæ conclude the series of recent Sauria; but we have still to notice a few groups of fossil species which have no living representative. The first of these is the family of the *Palæosauridæ*, characterized by their long, thin, pointed teeth, which are imbedded in sockets in the furrow of the jaws, and thus make an evident approach to the Crocodiles, to which the first specimens discovered were referred. The hind legs were much longer than the anterior, and the toes were well developed, and five in number on each foot. These Reptiles appear to have resembled the Varanidæ in their general organization; they are found in the new red sandstone.

Nearly allied to them is a small family, the *Dicynodontidæ*, which resemble the Tortoises in the form of the head and jaws; the orbits being completely closed, and the jaws compressed, sharp and destitute of teeth, with the exception of a single pair of long fangs which project downwards from the upper jaw.

The *Mosasauridæ* differ from the preceding in having the teeth of the jaws compressed, sharp-edged, and supported upon a socket in a shallow furrow of the jaws; the palate is also armed with teeth. The head was much elongated, and the mouth very wide; the limbs are imperfectly known, but the tail was compressed and resembled that of the Crocodile. The Mosasauridæ were gigantic Lizards, the remains of which occur principally in the chalk.

The last family of extinct Lizards is that of the *Dinosauridæ*, a group of gigantic Reptiles which appear to have made a nearer approach to the Mammalia than any other members of their class. The teeth are usually inserted into separate sockets; and the crown of the teeth is either conical and sharp-edged, or notched somewhat in the same manner as the teeth of the Iguana, and the mode in which they have been worn down shows that they were employed in the mastication of vegetable substances.

The structure of the skeleton is very remarkable. The sacrum is composed of five amalgamated vertebræ, a structure which reappears amongst the Mammalia, but occurs in no other Reptiles. The bones of the limbs are exceedingly strong, and appear to indicate that the animals supported themselves at a greater height from the ground than is usual with the Reptiles; in fact, in almost all points of their osteology they exhibit a wonderful analogy with the large Pachydermatous quadrupeds. This circumstance becomes still more remarkable when we consider that these gigantic Reptiles, some of which attained a length of from thirty to forty feet, are found in the oolitic and wealden formations, and that their place is taken very shortly afterwards in the lower tertiary strata by these very herbivorous Pachydermatous Mammalia. It

is supposed that the *Dinosauridæ* frequented the banks of streams; and the abundance of their remains in the Wealden formations, which are considered to represent the deltas of ancient rivers, renders this supposition exceedingly probable.

There is another group of fossil Reptiles which, although the number of known species is few, must be regarded as constituting a peculiar order. These are the *Pterodactyles* (Fig. 91), the remains of which are found principally in the oolites; they are particularly abundant in the neighbourhood of Solenhofen. These extraordinary Reptiles had a very long head, with an enormously wide mouth, armed with long teeth, which are inserted into regular sockets in the jaws. The whole skull, in its form and in the arrangement of the orbits, presents a considerable resemblance to that of a bird; and it appears that in some cases the teeth were confined to the hinder portion of the jaw, the anterior part being covered by a sort of horny beak. The neck is very long, and composed of stout vertebræ; the skeleton of the trunk, on the contrary, appears weak, and the vertebral column terminates in a short tail. The structure of the anterior limbs is exceedingly remarkable, as nothing of the kind occurs in any other animal, whether living or fossil. The shoulder-blade, which is by no means strong, gives support to a short thick humerus, which in its turn bears the bones of the fore-arm, which are more than twice its length. At the extremity of the fore-arm is a hand, composed of three or four short slender fingers, forming its inner portion, and of an exceedingly long outer finger, which is often equal to the body and neck in length. The hinder limbs are elongated and slender, and terminated by four or five small toes.

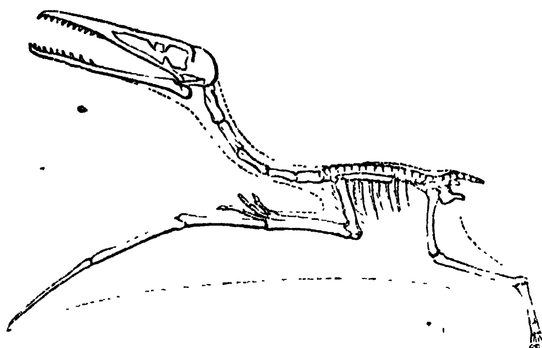


Fig. 91.—Skeleton of Pterodactylus, with the supposed outline of the animal.

It is generally supposed that between the elongated outer finger of the fore-hand and the hinder limb a broad membrane was extended on each side of the body; by the assistance of which these animals were enabled to flutter about in the air like the Bats, and probably, like these, in pursuit of the same objects, as the remains of insects are not uncommon in the very strata where the Pterodactyles most abound. If these suppositions be correct,—and the only circumstance that tells against them is the weakness of the scapular arch,—the resemblance between these singular creatures and the Bats is exceedingly striking; for they are evidently organized not only for supporting themselves in the air upon their leathern pinions, but also for a certain amount of terrestrial progression, and indeed the portion of the anterior limbs that is devoted to this purpose is much greater than in the Bats. It is, however, doubtful whether a membrane extended in the place indicated could do more, considering the general conformation of the creature, than support it in the air when leaping from place to place, in the same manner as the membranous lobes at the sides of the little Dragons.

This is also the best place in which to refer to another group of extinct Reptiles, which appears to be more closely allied to the Crocodiles than to any other order. They are, in fact, placed in the same order as the Crocodiles by some authors; but it will perhaps be best to regard them as forming a distinct group, for which the name of *Enaliosauria* has been proposed.

These Reptiles were generally of gigantic size, some of them attaining a length of thirty feet or more; they were exclusively adapted to an aquatic life, and from the strata in which their remains are met with appear to have been entirely marine in their habits. In the form of the head they greatly resembled the Crocodiles, and the jaws were likewise armed with strong conical teeth inserted into distinct sockets. The eyes were of large size, and surrounded by a circle of bony plates.

In the structure of the vertebral column these animals resembled the Fishes, and differed from all other Reptiles with the exception of some of the extinct Crocodiles, the bodies of the vertebræ being concave on both sides. The posterior extremity of the vertebral column was continued into a tail, often of considerable length, and which was probably furnished with a broad, fin-like expansion. The ribs were well developed, and attached to a large sternum. The extremities were modified so as to form large powerful paddles, presenting a considerable resemblance to the paddles of the Turtles or the Whales. The scapular and pelvic arches supporting these organs were of large size; the fore and hind feet were represented by a number of small bones, laid close together to form the paddles; but the intervening bones of the legs were reduced to a comparatively rudimentary condition. The skin appears to have been completely naked.

These animals exhibit two very distinct forms. In the *Ichthyosauridæ*, or Fish Lizards (Fig. 92), the body was completely fish-like in its form, produced posteriorly

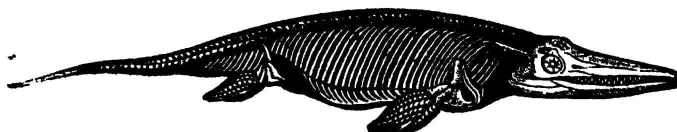


Fig. 92.—Ichthyosaurus.

into a long tail, which was probably the principal agent in locomotion, the paddles being of comparatively small size. The head was large, and produced into a long pointed snout; the upper jaw was composed principally of the intermaxillary bones; and the teeth were longitudinally striated. These formidable creatures, some of which exceeded thirty feet in length, were inhabitants of the seas; and their whole structure being evidently adapted to the most active movements in the water, they must have been exceedingly dangerous enemies to the other marine animals of those ancient periods. Their principal food consisted of fishes, as appears from the fish-bones and scales which are frequently found intermixed with their remains.

The remains of these gigantic Reptiles are found in the secondary formations, and principally in the lias and oolite.

Nearly allied to these are the *Nothosauridæ*, in which, however, the maxillary bones reach nearly to the extremity of the upper jaw; and the teeth, which are placed at a greater distance from each other than in the Ichthyosauridæ, are not striated. These reptiles are found in the Trias.

The second principal form is that of the *Plesiosauridæ* (Fig. 93), in which the head is of small size, and supported at the extremity of a long, flexible, snake-like neck; the body is short, and terminated posteriorly by a short tail, and the extremities are of much greater comparative size and power than in the Ichthyosauridæ. Nevertheless there can be no doubt from the general conformation of the Plesiosaurus that its movements in the water must have been far less active than those of the Ichthyosauri; and it has been supposed, not without probability, that it paddled along close to the surface of the water, with its long neck raised and arched in the manner of that of the swan, ready to be plunged into the water the moment some luckless fish or other marine animal came within its reach; or that it frequented shallow waters near the coasts, where it could conceal itself in the midst of beds of seaweeds, or in other sheltered situations, whilst the great length of its neck would enable it to keep its head at the surface for the purpose of respiration. However this may be, the structure of the *Plesiosauridæ* is one of the most singular in the whole class of Reptiles. They are found principally in the lias with the *Ichthyosauri*, which they nearly equal in length; although, from the form of their bodies and the small size of the head, they could never have been so active or so formidable as those gigantic Reptiles.

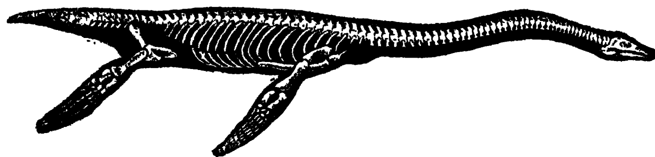


Fig. 93.—Plesiosaurus.

ORDER III.—LORICATA.

**General Characters.**—This order, the first of those in which the anal aperture is longitudinal and the dermal skeleton composed of bony matter, includes only the living Crocodiles and some similar extinct forms. In the form of the body these animals resemble the Lizards, with which, in fact, they have generally been arranged. Their legs are always well developed, and terminated by distinct toes, which, however, are frequently united by a swimming membrane.

The head of the Crocodiles is usually much elongated, being, in some species, produced so as to form a long slender snout, and the maxillary bones extend nearly to the apex of the upper jaw, the intermaxillaries being of small size, and forming only its extremity. The palatine bones form a complete roof to the mouth, and separate that cavity from the nasal passages, which communicate with the pharynx through a complete foramen at the hinder portion of this bony plate. The lower jaw is articulated to a process arising from the back part of the head, which projects backwards, as in the Snakes, but is immoveably attached to the skull; hence the mouth is very wide, and when in the act of opening it appears as though both jaws moved, which, in fact, was long believed to be the case. The lower jaw is composed of no less than six bones on each side, arranged together in such a manner as to give the greatest amount of elasticity and strength, with the least possible amount of material (see OWEN on the Skeleton, Vol. I., p. 209), and it is only the last and longest of these bones that is furnished with teeth.

The teeth are confined to the jaws, in which, however, they stand in a most formidable and close array. They are inserted into regular sockets, and are of an

acutely conical form, usually striated on the surface, as in the *Ichthyosauri*, with which they also agree in the mode in which the old teeth are replaced, the new ones pushing forward into the cavity of the root of their predecessors, and taking their place when the old teeth fall out in consequence of the absorption of their roots One of the teeth in the lower jaw, on each side, is usually much larger than the others, and fits into a notch or cavity in the upper jaw.

The cervical vertebræ are furnished with small false ribs, or rib-like processes, which, by their contact, greatly diminish the flexibility of this part of the body, to such an extent, in fact, that it is said the Crocodiles have considerable difficulty in turning when on land, so that they may easily be escaped by a process of *doubling*. The ribs are strong, formed each of two bones, and uniting below with a large sternum, which is continued along the whole lower surface of the abdomen, and in this part of its course gives rise to false ribs, which do not attain the spinal column. The caudal vertebræ are furnished with long spinous processes, which give a compressed form to the tail. The limbs are short and stout, but evidently incapable of supporting the whole weight of the creatures; when on land, accordingly, the belly rests upon the surface, and they may rather be said to push themselves along than to run. The anterior feet are furnished with five, the posterior with four, toes, of which the three innermost on each foot are armed with claws; the toes of the anterior feet are usually nearly free, but those of the hinder pair are entirely or partially united by a membrane.

The nostrils are situated quite at the extremity of the snout, and furnished with a valve, by means of which the ingress of water into the nasal cavities can be prevented when the animal is immersed in that element. The eyes are of considerable size, placed far back upon the head, and furnished with well-developed lids; their pupils form a perpendicular slit when exposed to daylight. The external ear can be closed at pleasure by a pair of valves. The tongue is large and fleshy, and immoveably attached to the bottom of the mouth, a character which occurs in no other Reptiles: this induced the ancients to believe that the Crocodile was destitute of this organ

The structure of the dermal skeleton in these animals distinguishes them at the first glance from all other Reptiles. It consists of numerous large, square, bony plates, developed in the leathery corium, and forming a complete shield, covering the dorsal surface; these plates are more or less distinctly keeled, and the keels on the caudal plates are very high, forming a compressed ridge, which becomes double towards the base. The lower part of the body is covered with a wrinkled skin, which contains only small scale-like plates. The scales of the back of the neck are usually of peculiar form, and frequently form two distinct groups, which have been denominated *nuchal* and *cervical shields*. Their number, form, and arrangement are often employed as characters for the discrimination of the species. Under the throat there are two small orifices, which communicate with glands, from which the peculiar musky secretion characteristic of these animals is produced.

The lungs do not penetrate into the abdomen, as in other Reptiles, and there is even a trace of a diaphragm, or partition between the thoracic and abdominal cavities, in the form of a few muscular fibres. In other respects their anatomy greatly resembles that of the Lizards, except that the ventricles of the heart are completely separated, and that the male generative organ is retracted within the cloaca, which opens externally by a longitudinal slit.

They are all oviparous animals. Their eggs, which are inclosed in a hard covering,

are laid by the females in warm sandy places, or in a heap of mud and vegetable matters, where they are hatched by the heat of the sun, and it appears that the parents take no further care of their progeny. They abound in the fresh waters of all warm climates, and are exceedingly voracious creatures, generally destroying their prey by drowning it, although they are unable to swallow anything under water. They are said to hide their prey for some days under water, until it begins to putrefy, before they commence eating it.

**Divisions.**—The recent Crocodiles form only a single family, but two others have been established for the reception of some fossil forms. These are characterized particularly by differences in the structure of the bodies of the vertebræ. In the *Teleosauridæ* these bones are concave at both extremities, like those of Fishes, whilst in the *Steneosauridæ* they are convex in front and concave behind. In their general form the Reptiles composing both these families closely resembled the Gangetic Crocodile (*Gavialis gangetica*); their remains occur principally in the lias, oolite, and wealden formations.

In the family *Crocodilidæ*, or true Crocodiles, including the recent, and some fossil species, the bodies of the vertebræ are convex behind, and concave in front. In the general form of the body these animals exhibit a very great similarity; but the structure of the head at once distinguishes the Gangetic Crocodile, or Gavial (*Gavialis gangetica*), from all others. In this animal the jaws are produced to an enormous length, forming a long slender snout, at the extremity of which there is a large cartilaginous protuberance, in which the nostrils are situated. The teeth are very numerous, and nearly equal in size throughout the whole of the jaws. The hind feet are palmated to the extremities of the toes. This species is found abundantly in the fresh waters of India, where it sometimes attains a length of twenty-five feet. It was known to the ancients, Ælian mentioning the existence of a Crocodile in the Ganges which had a horn at the extremity of its nose.

The Crocodiles properly so called, of which the common Crocodile of the Nile (Fig. 8) may be regarded as the type, resemble the Gavial in most of their characters, but the snout is oblong, obtuse and flattened, and two of the teeth in each jaw are longer than the others, forming canines, of which those of the lower jaw are received into a notch in the edge of the upper. Of these animals several species have been described, and they are common to both hemispheres. The best known species is the Nilotic Crocodile (*Crocodilus vulgaris*), which attains a length of twenty-five or thirty feet, and is undoubtedly one of the most formidable and ferocious inhabitants of the rivers of Africa. On land, from the difficulty which it experiences in turning quickly round, the Crocodile is by no means dangerous; but when in the water, his powerful compressed tail enables him to move with great rapidity and in every direction in pursuit of his prey. This consists, to a certain extent, of fish, but any animal of moderate size that comes within his reach is equally welcome, and many instances are on record of men being carried off by Crocodiles in crossing rivers. Dogs were said to be a favourite food of the Crocodile, who seized them when they came to the edge of the water to drink; in fact the ancients believed that the dogs of Egypt were so well aware of the Crocodile's predilection for their flesh, that they always ran along the bank while engaged in drinking. Nearly allied and equally dangerous species are found in the rivers of Western and Southern Africa, and in the rivers and tanks of India and the adjacent islands. The Alligators of the West Indian Islands are also true Crocodiles.

A third group is formed by the Alligators of the American continent, which have a broad, obtuse snout, and the canine teeth of the lower jaw received into a pit of the upper. Their hind feet are never completely webbed, and in some instances the membrane is almost entirely absent. These animals are pretty generally distributed over the continent of America; but are more abundant and attain a larger size in the warmer regions. The best known species is the *Alligator Mississipensis* (Fig. 94), which



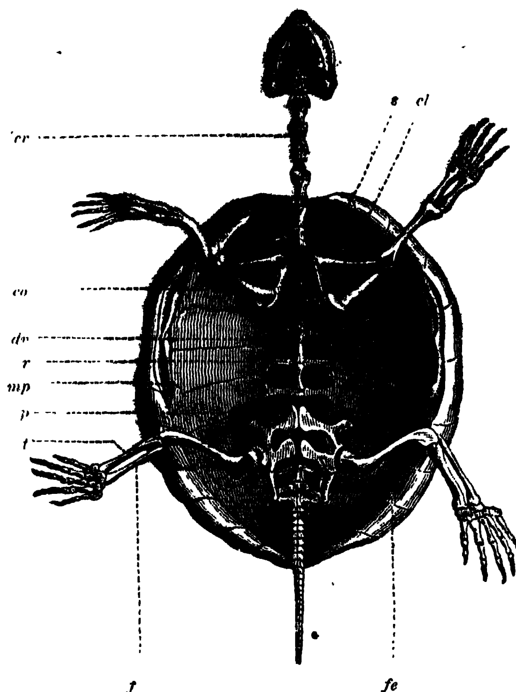
Fig. 94.—Alligator Mississipensis.

is common in the southern parts of the United States, where it inhabits both the rivers and the pieces of stagnant water in the morasses. Its ordinary length seems to be from fifteen to eighteen feet, but it is occasionally met with of larger size; and Bartram says, that in Florida the Alligators are sometimes upwards of twenty-three feet long. They prey upon almost any animal that comes in their way, and Dr. Holbrook states that in places where they abound no animal of the size of a dog can cross even small streams without being dragged down, drowned, and devoured. They are also said to strike their prey from the banks with their tails, bending the body nearly into a circular form, so that the victim is thrown into the mouth, or at all events into its immediate neighbourhood; and there is no doubt that they defend themselves from danger by powerful blows with the tail. At the approach of winter the North American Alligators bury themselves in holes in the banks of their aquatic abodes, and pass the cold season in a

state of torpidity. At this time they are often dug out of their retreats by the negroes, who esteem the tail a delicacy, and Dr. Holbrook states that it is tolerable eating, although Catesby found its peculiar taste and odour disagreeable. They are also taken by means of a shark-hook baited with a piece of flesh, at which they bite readily. In the spring and early summer months, they make what Catesby calls "a hideous bellowing noise;" this is especially the case during the breeding season, when the males often have tremendous combats amongst themselves.

ORDER IV.—CHELONIA.

**General Characters.**—The distinguishing characteristic of the Chelonian reptiles, and the one which in fact enables us to recognize the members of this order at the first glance, consists in their possession of a complete bony case, within which the head and limbs can frequently be more or less completely retracted. This case consists of two large bony plates, of which the upper, which is more or less convex, is called the *carapace*, whilst the lower one, which is usually perfectly flat, is denominated the *plastron*. These two plates are united at their lateral margins, leaving an anterior and posterior aperture for the protrusion of the head, tail, and limbs. At the first glance it would seem almost impossible to refer these singular animals to the ordinary vertebrate type, but a little examination of their anatomy shows that their different parts are only modifications of the same structure that we have seen to prevail throughout the preceding groups.




* Fig. 95.—Skeleton of a Tortoise, with the plastron removed. *cv*, cervical vertebræ; *co*, coracoid bone; *dv*, dorsal vertebræ; *r*, ribs; *mp*, marginal plates; *t*, tibia; *p*, pelvis; *f*, fibula; *fe*, femur; *s*, scapula; *cl*, clavicle.

When viewed from beneath (Fig. 95) the central line of the upper shield or carapace is seen to be composed of the bodies of the dorsal vertebræ, on each side of which are seen the broad flattened ribs, usually eight in number on each side, which are immoveably attached to each other by dentated sutures. The ribs run almost to the margin of the carapace, which however is completed by a series of bones called *marginal plates*, which have been regarded as analogous to the sternal or cartilaginous portion of the ribs in other Vertebrata, but

which are now generally considered to be dermal bones. The costal plates, as the flattened ribs are called, are also regarded as belonging partly to the dermal skeleton. In some instances the ribs are only dilated near their basal portion, and taper off towards the margin of the carapace, so as to leave considerable spaces between them, which are covered only by the horny epidermal shields, or, in some instances, by a leathery skin; in these cases, however, the marginal plates are completely developed.

Externally the centre of the carapace is composed of a single series of bony plates, supported upon the spinous processes of the vertebræ, of which they have been considered as mere expansions. It appears, however, that these also partly belong to the dermal system, the spinous processes only taking part in the formation of eight of these plates (the second to the ninth), whilst the first, or *nuchal plate*, and some of the last of the central plates of the carapace, are entirely developed in the corium.

The plastron, which usually consists of four pairs of bony plates, and of a single median one, is regarded as consisting of a greatly expanded sternum, probably united with peculiar dermal ossifications; it is usually firmly attached by suture with the marginal plates of the carapace, and thus forms a solid bony box, open at each extremity. The outer surface of the whole of this bony case is covered with numerous horny epidermal plates, which vary greatly in number, size, and form, and which by no means correspond in their arrangement with the bony plates beneath them. They do, however, present some analogy in this respect, the horny plates of the carapace being generally divisible into three groups, namely, a central series, the *dorsal* shields; a series on each side of these, the *lateral* shields; and a series surrounding the whole carapace, the *marginal* shields.

From either extremity of the fixed portion of the vertebral column, which, with its appendages, constitutes the case or shell of these animals, projects a flexible portion of the same column. The anterior flexible portion consists of the cervical vertebræ, which are quite destitute of transverse processes, and are thus endowed with so much freedom of motion, that, although the neck is not unfrequently of considerable length, it can frequently be retracted, together with the head, beneath the carapace. The skull is of a semi-oval form, abruptly truncated behind and somewhat pointed in front, and the orbits are completely inclosed. The jaws are strong, but short, and the upper jaw and palatine bones are firmly attached to the skull. There is no appearance of teeth in any part of the mouth, but the jaws are very sharp at the edge and covered with horny plates, so that they present a considerable resemblance to the beak of a bird. The tail, or posterior moveable portion of the vertebral column, is composed of numerous vertebræ; it is usually short and tapering, but sometimes attains a considerable length.

The most singular point in the remaining osteology of these animals, is the fact that the scapular arch, which is usually applied to the exterior of the ribs, is here completely hidden within the bony case. The scapula, or shoulder blade, articulates with the carapace, and the clavicle with the plastron, and there is a third bone of large size (the *coracoid bone*) which assists in the formation of the shoulder joint, but instead of articulating with the sternum, as in the Birds, has its posterior extremity free. The pelvic arch is immoveably attached to the interior of the carapace. The limbs are always four in number, and fully developed, but short and stout; they exhibit several modifications of form, which are characteristic of the different families. All these moveable portions of the animals are merely covered with a sort of scaly skin.

In their general internal structure the Chelonia agree pretty closely with the other Reptiles. The heart is composed of three cavities, the partition between the ventricles

being very incomplete, so that the venous and arterial blood can mix freely in that cavity. The lungs are of very large size, and extend far into the cavity of the body; but as the ribs are immoveable, respiration is effected, as in the Batrachia, which are destitute of those bones, by a process very analogous to swallowing. The tongue is short, fleshy, and completely moveable; the ears are distinctly visible, and the eyes well formed, and furnished with moveable lids. The urinary bladder is of large size, and discharges its contents into the cloaca, which also contains the male generative organ, and opens by a longitudinal slit, or a circular orifice, in the base of the tail.

The Chelonian Reptiles are usually sluggish and inactive animals, the slowness of the terrestrial species being even proverbial. They are, however, exceedingly tenacious of life; they will live for a long period without any nourishment, and will even continue to give signs of life for some time after they have been deprived of their heads. They are found principally in the warmer regions of the earth, where they generally subsist upon vegetable substances, although many of the aquatic species also devour small animals. They are oviparous, and the eggs are covered with a hard shell.

**Divisions.**—These Reptiles may be divided into five families. In the *Chelonidæ* or Turtles, which are pre-eminently aquatic in their habits, the limbs are all converted into large, flattened, fin-like organs, the toes being completely concealed by a common skin. The anterior pair of members is always considerably longer than the posterior, and both the anterior and posterior limbs are frequently furnished with one or two nails on the outer margin, which, however, sometimes disappear as the animal increases in age. The bony case of these animals is too small for the reception of the head and limbs, and these parts are, consequently, always more or less protruded. The ribs are narrowed towards the extremity, so as to have spaces between them at that point, and the bony plates of which the plastron is composed are also separated by intervals, which are filled up with cartilage. The head is flattened above, and the jaws horny, very sharp, and beak-like.

The Turtles are all inhabitants of the sea. They are excellent swimmers, and rarely approach the shore except for the purpose of depositing their eggs, which they do upon sandy coasts. Most of them feed upon seaweeds; but a few also devour Mollusca and other small marine animals. The flesh of the former affords a wholesome and delicious food, and they are in consequence much sought after, and imported into Europe in considerable quantities, whilst the carnivorous species are not only disagreeable, but even unwholesome, or, according to some writers, poisonous, and these are only collected for the sake of the abundant supply of oil which they yield.

The best known of the edible species is the Green Turtle (*Chelonia midas*), which is found abundantly in the seas of warm climates, and of which great numbers are imported alive into the different European countries. In tropical climates this turtle attains a length of five or six feet, and a weight of five or six hundred pounds; its flesh is exceedingly delicate, and, when not rendered indigestible by the ingenuity of cooks, is regarded as a very wholesome food. The eggs of this, and, indeed, of all the species of Turtles, are also eaten and considered a great delicacy. At the Island of Ascension, where these animals appear to abound to a greater extent than in any other part of the world, they are generally taken by watching them when they visit the shore to deposit their eggs; they are then turned over on their backs, and in this helpless position they remain until their captors, having secured as many as they require in the same manner, carry them off to the ships. This, however, appears only to apply to the larger individuals, as Sir J. Alexander states that the young ones,

immediately on quitting the egg, scuttle down to the water, and that they are not seen again until they are four or five hundred pounds in weight. In other places they are taken by striking them in the water with a sort of harpoon, and Mr. Darwin describes another mode of capture as practised at Keeling Island. He says, "the water is so clear and shallow that although at first a Turtle quickly dives out of sight, yet, in a canoe or boat under sail, the pursuers, after no very long chase, come up to it. A man, standing ready in the bows at this moment, dashes through the water upon the Turtle's back; then, clinging with both hands by the shell of the neck, he is carried away till the animal becomes exhausted and is secured. It was quite an interesting chase to see the boats thus doubling about, and the men dashing into the water, trying to seize their prey."

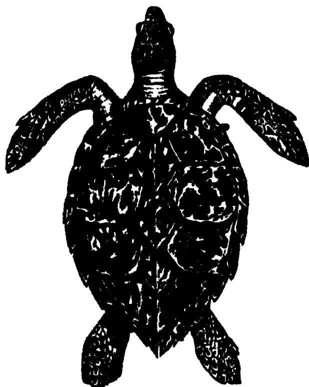


Fig. 96.—Hawk's-bill Turtle (*Chelonia imbricata*).

Another important species of this family is the Hawk's-bill Turtle (*Chelonia imbricata*, Fig. 96), so called from the curved and pointed form of the upper jaw, which certainly presents no very distant resemblance to the hooked bill of a predaceous bird. It is of a smaller size than the Green Turtle, rarely exceeding three feet in length, and its flesh is of very indifferent quality, if not absolutely unwholesome; but it is much sought for on account of the beauty of the horny plates with which the carapace is covered, which constitute the true *tortoise-shell* of commerce. This Turtle is found in the tropical seas of both hemispheres, and has also been known to stray into the Mediterranean. The best tortoise-shell, according to M'Culloch, "is that of the Indian Archipelago; and the finest of this quarter is obtained on the shores of the Spice Islands and New Guinea."

One of the largest species is the Loggerhead Turtle (*Chelonia caretta*), which presents some resemblance to the Hawk's-bill Turtle in the form of its upper jaw. This animal not only inhabits the seas of the tropics, but also extends to a considerable distance beyond those regions, and occurs not unfrequently in the Mediterranean. Its size is sometimes enormous; Dr. Shaw mentions a skull of this species, which measured more than a foot in length, and was said to have been obtained from a specimen weighing above sixteen hundred pounds. It is exceedingly voracious, feeding principally upon Mollusca, the shells of which it crushes between its powerful jaws. Its flesh is good for nothing, and its epidermal scales are thin, and want the beauty which causes those of the Hawk's-bill Turtle to be so highly prized; but it furnishes a considerable quantity of an oil that burns well.

A species which appears to be usually still larger than the preceding is the Leathery Turtle (*Sphargis coriacea*), which is remarkable in this group from its having the surface of the shell covered with a leathery skin instead of the usual horny plates. This gigantic Turtle, which certainly attains a length of about eight feet, and is said to weigh as much as one thousand pounds, generally inhabits the Mediterranean, but specimens occasionally occur in the Atlantic Ocean, and sometimes even reach the American coasts. It has also been taken on the coasts of France and England. Lacepède supposes that the shell of this animal was employed by the ancient Greeks

in the formation of their lyres, which are said to have originally consisted of strings, or wires, attached to the bones of some marine tortoise. The back of the carapace, which is of an elongated cordate form, is marked by five longitudinal ridges; and Dr. Shaw considers that this resemblance to a stringed musical instrument may have given rise to the appellation of "the *lute*," conferred upon this species in some continental countries. Its flesh is of no value.

In the second family, the *Trionycidæ*, or Soft Tortoises, the carapace is still more incomplete than in the Turtles, the ribs being only expanded and united at the base, and running out to the margin in the form of the spokes of a wheel. This imperfect carapace is covered with a tough leathery skin, which is flexible at the margin, and as in the Turtles, the head and limbs are incapable of being retracted within the bony case. The head is rather small, and pointed in front; the neck is very long; the horny jaws are covered with fleshy lips; and the nostrils are produced into a short cylindrical trunk. The feet are all short, and strong, furnished with five toes, which are united by a strong web, and of which three on each foot are furnished with claws.

The Soft Tortoises live in the rivers of the warmer parts of Asia and Africa, and one or two species are found in the North American waters. They are active predaceous animals, feeding principally upon fish, but occasionally concealing themselves amongst the reeds and sedges of the banks, whence they rush out and seize birds and small reptiles. Thus the *Trionyx ferox*, or Snapping Turtle (Fig. 97), which inhabits the rivers and lakes of North America, destroys great quantities of young Alligators; and another species, the *Trionyx niloticus*, which is found in the African fresh waters, is said to be equally destructive to the young of the Crocodile. They seize their prey by suddenly darting forward the long neck, and, when provoked, the *Trionyx ferox* bites very severely; it is even said occasionally to attack men when bathing, and to bite pieces out of them. Its flesh, however, is said to be superior to that of any of the Chelonia.

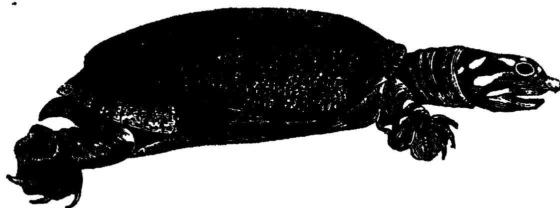


Fig. 97.—The Snapping Turtle (*Trionyx ferox*).

The *Chelydidæ*, which form the third family, present a considerable resemblance to the Trionycidæ; but the head and neck are capable of being retracted to a certain extent beneath the carapace, which is covered with horny shields. The head is broad and depressed, with the nose usually prolonged into a proboscis, and the mouth is furnished with soft lips; both the head and neck are frequently adorned with membranous lobes of remarkable forms. The feet, which are not capable of being retracted within the shell, are short and stout, furnished with five toes, which are more or less united by a web, and of which either four or five are always armed with claws.

Like the Soft Turtles, these animals live in the ponds and rivers of warm climates, where they feed principally upon Fish. The species figured *Chelys matamata* (Fig. 98) is an inhabitant of South America, and was formerly very abundant in the rivers of Guiana; but it is said to have become scarce in that locality from the great numbers that are taken for the sake of their flesh, which is considered very good.

Nearly allied to these is the great family of the *Emydidæ*, the species of which are very generally distributed over the globe. They agree with the preceding in the structure of the feet, but the carapace is completely ossified, and its bones united by sutures; the jaws are horny, and destitute of lips; and the head and neck can be completely retracted within the front of the shell. The nostrils are placed at the apex of the snout, but not prolonged into a proboscis.



Fig. 98.—Chelys matamata.

Like the preceding families, the *Emydidæ* are principally aquatic in their habits, although their feet are certainly well adapted for terrestrial progression. They feed upon small fishes and aquatic insects, and are generally of small size. They are found most abundantly in warm climates, but some of the species extend far into the temperate regions of the earth, several being inhabitants of the North American continent, whilst two are found in Europe, of which one occurs as far north as Prussia. The most remarkable species are the Box Tortoises (*Cistudo*), in which the plastron is divided by a transverse suture into two portions, which are united together and with the carapace by elastic ligaments, so that they are capable of being brought close to the carapace, closing the apertures of the shell completely when the animal is retracted. In some other species, on the contrary, such as the Alligator Tortoise (*Chelydea serpentina*) of North America, the limbs and feet are too large to be retracted within the shell.

The last family is that of the *Testudinidæ*, or Land Tortoises, in which the carapace is convex and solid, the ribs being united together throughout their length; the plastron is also solid, the feet short, stout, and somewhat clubbed, the toes being almost entirely concealed under the skin, and terminated by blunt nails, of which there are usually five upon each of the anterior, and four upon each of the posterior feet. The head is rather small, and covered with shields; the jaws are horny, and destitute of lips. The head, limbs, and tail can be completely retracted within the cavity of the shell, and in some cases the plastron is furnished with moveable lobes, by which the aperture can be completely closed. The surface of the carapace is covered with horny shields, which touch each other at the edges, and exhibit concentric lines of growth; at the hinder part of the carapace, immediately over the tail, the shields (*caudal shields*), which in the preceding

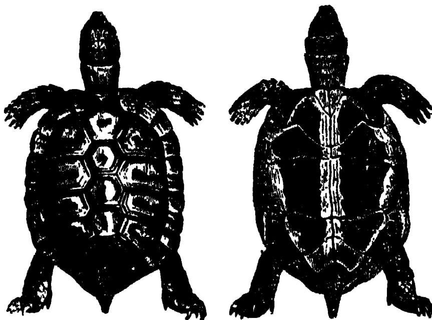


Fig. 99.—Common European Tortoise (*Testudo græca*), from above and below.

families are usually separate, are here united into a single broad plate. The Land Tortoises are generally of small size. They are terrestrial in their general habits, although most of them can swim when immersed in the water. They are very slow in their movements, and live entirely upon vegetable matter. Like the rest of the Chelonian Reptiles, they are far more abundant in warm than in temperate climates; a single species only, the *Testudo græca* (Fig. 99), is found in Europe, and this is confined to the countries bordering the Mediterranean. It is this species that may be so frequently seen hawked about the streets of London during the summer.

One of the largest species is the *Testudo indica*, or Indian Tortoise, which sometimes attains a length of three feet, and a species of equal size, inhabiting the Galapagos Islands, has been described by Dr. Gray under the name of *Testudo planiceps*. The Indian Tortoise is also found in those Islands, and Mr. Darwin has given the following interesting account of its habits.—"The Tortoise," he says, "is very fond of water, drinking large quantities, and wallowing in the mud. The larger islands alone possess springs, and these are always situated towards the central parts, and at a considerable elevation. The Tortoises, therefore, which frequent the lower districts, when thirsty, are obliged to travel from a long distance. Hence broad and well-beaten paths radiate in every direction from the wells even down to the sea coast, and the Spaniards, by following them up, first discovered the watering-places. When landed at Chatham Island, I could not imagine what animal travelled so methodically along the well-chosen tracks. Near the springs it was a curious spectacle to behold many of these great monsters—one set eagerly travelling onward with outstretched necks, and another set returning, after having drunk their fill. When the Tortoise arrives at the spring, quite regardless of any spectator, it buries its head in the water above its eyes, and greedily swallows great mouthfuls, at the rate of about ten in a minute. The inhabitants say each animal stays three or four days in the neighbourhood of the water, and then returns to the lower country. . . . For some time after a visit to the springs, the urinary bladder of these animals is distended with fluid, which is said gradually to decrease in volume, and to become less pure. The inhabitants, when walking in the lower district, and overcome with thirst, often take advantage of this circumstance by killing a tortoise, and if the bladder is full, drinking its contents. In one I saw killed, the fluid was quite limpid, and had only a *very slightly* bitter taste. The inhabitants, however, always drink first the water in the pericardium, which is described as being best." The Tortoises are exceedingly numerous in the Galapagos Islands, and their flesh is said to be exceedingly delicate and good. Mr. Darwin says it "is largely employed, both fresh and salted; and a beautifully clear oil is prepared from the fat. When a Tortoise is caught, the man makes a slit in the skin near its tail, so as to see inside its body, whether the fat under the dorsal plate is thick. If it is not, the animal is liberated, and it is said to recover soon from this strange operation."

Small as the existing species of Tortoises are, it appears that in former periods of the earth's history, at least one species of gigantic size belonging to this family dragged its ponderous bulk over the soil of India; this is the *Colossochelys Atlas*, the remains of which were discovered in the Sewalic Hills by Falconer and Cautley. Those gentlemen think it possible that this gigantic Reptile, which measured about eighteen feet in length, probably existed down to the human era, and that it may thus have given rise to the extraordinary traditions of the Hindoos, which attribute most important parts in the creation of the world to gigantic Tortoises.

With the Tortoises we conclude the series of Reptiles, and pass now to the con-

sideration of a class of animals which are as generally regarded with favour, as the others with disgust and aversion.

## Class IV.—Aves, or Birds.

**General Characters.**—The class of Birds is undoubtedly one of the most distinctly circumscribed in the whole series of animals. Its position in the scale of classification is no less distinctly marked, for birds are evidently superior to the Reptiles, and inferior to the Mammalia in many points of their organization; and yet they cannot be regarded as forming an intermediate group between these classes, which in reality approach each other more closely than either of them do to the Birds. This may furnish an additional argument against the views of those writers who consider the whole Animal Kingdom as an unbroken chain, ascending step by step from the lowest forms of organized existence, till it reaches its highest development in man.

The general form of the body in birds is oval; the legs, two in number, are usually placed in such a manner as to fall under the middle of the body, and the anterior limbs are modified to form organs of flight. The head is usually of small size, produced in front into a pointed beak, which is covered with horny matter; the neck is long and very flexible, and the tail reduced to a rudimentary condition. In the clothing of the body birds also present a remarkable difference from all other vertebrate animals; it consists of a number of peculiar dermal appendages, well known as feathers, the structure of which will be explained hereafter.

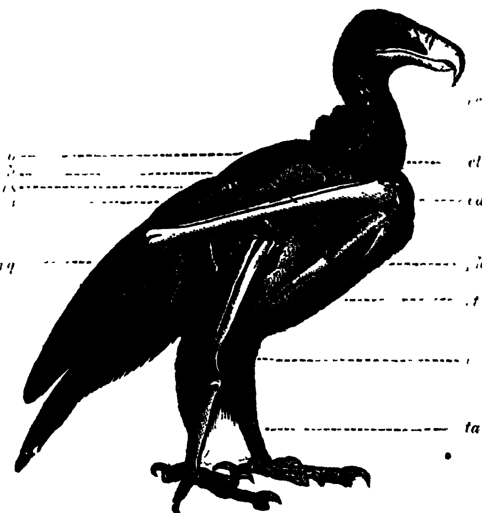



Fig. 100.—Skeleton of Vulture.

*vc*, cervical vertebræ; *rs*, sacral vertebræ; *vq*, caudal vertebræ; *cl*, clavicle; *h*, humerus; *o*, bones of forearm; *ca*, carpus; *ph*, phalanges; *st*, sternum; *f*, femur; *t*, tibia; *ta*, tarsus.

The skeleton of these animals is perfectly ossified, and the substance of the bones generally exhibits a greater degree of hardness than in any other Vertebrata. This solidity and consequent weight of the matter of which the bones are composed, which would seem to be out of place in animals intended for habitual residence in the air, is compensated for by a peculiarity in the structure of the bones, which occurs in no other group of animals. The greater part of the bones are hollow, and their cavities are filled with air, which passes into the interior through small openings seen on the surface of the bone, which communicate with the numerous air-cells of the body. In some birds which, although endowed with great power of flight, have bulky and heavy bodies, these air-cavities are found in almost every bone, whilst in a few whose habits are entirely terrestrial, nearly all the bones are destitute of air-cells. In young birds also,

which have not attained the power of flight, the bones are filled with marrow; but this gradually gives way to the ordinary air-cavities.

The structure of the skeleton is of course remarkably modified to suit the bird for its aërial habits; but the recognition of its different parts is by no means difficult. The head is usually of small size, and the bones of the skull, which in young birds are distinct, are generally completely amalgamated in the adults so as to form a continuous bony capsule (Fig. 101). The size of the skull and cerebral cavity is usually much larger in proportion to the facial bones than in the Reptiles, and the former often appears to predominate to a still greater extent, in consequence of the existence of large air-cells in the interior of the bone. On the surface of the skull there are usually several strong ridges for the attachment of muscles; the occipital foramen is situated on the lower part of the back of the skull, and the occipital condyle is simple, convex, and sometimes globular, so as to give the head great mobility. The openings of the ears are placed on each side of the back of the skull, close to the base, and immediately beneath these are articulated the tympanic bones, which give support to the lower jaw. In front of the skull, on each side, are the orbits, which are usually of enormous size, and very rarely completely inclosed; they are separated by a bony partition, which, however, is usually perforated.

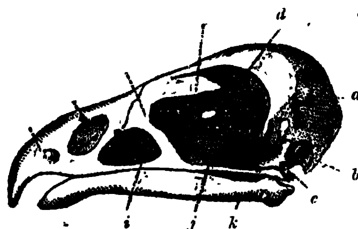


Fig. 101.—Skull of an Eagle.
*a*, cranium; *b*, tympanum; *c*, tympanic bone; *d*, interorbital partition; *e*, lachrymal bone; *f*, its superior branch; *g*, nostril; *h*, upper jaw; *i*, nasal fossal; *j*, jugal bone; *k*, lower jaw.

The facial bones are produced into a beak of variable length, which is attached to the skull in such a manner as to retain a certain amount of mobility, although this depends rather upon the elasticity of the material than upon an articulation. Upon this the nostrils are seen; they are very variable in size, and the bony septum is frequently wanting, so that the nostrils form a passage from side to side of the beak.

When viewed from beneath (Fig. 102), the centre of the sphenoid bone is seen to project in front of the occipital to a considerable distance below the orbit; this supports a more or less elongated bone (the *pterygoid*) on each side, which runs obliquely backwards, and articulates at its upper extremity with the tympanic bone. In front of this are the bones of the upper jaw and palate, which are all firmly united together in front. The intermaxillary bones constitute the greater part of the edge of the jaw; the maxillaries give rise to a long slender bone (the *jugal bone*), on each side, which is directed backwards, and articulates with the tympanic bone. The palate is formed of a pair of large palatine bones and a vomer; the former are continued backwards till they articulate either with the

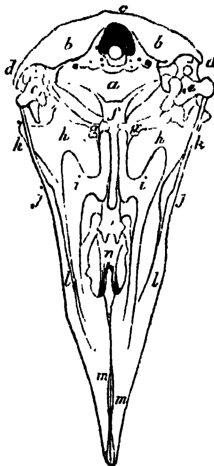


Fig. 102.—Cranium and upper jaw of Raven, seen from beneath.
*abbc*, occipital bone; *dd*, temporal bones; *ee*, tympanic bones; *f*, sphenoid; *gg*, pterygoid bones; *hh*, orbital plates; *ii*, palatine bones; *jk*, jugal bones; *ll*, maxillary bones; *mm*, intermaxillaries; *n*, nasal aperture.

sphenoid bone or with the tympanic bones. The lower jaw is always articulated with the tympanic bones; it is composed originally of twelve pieces, and in some birds it retains this condition for a considerable time; but in the adult state these pieces are always amalgamated so as to form a single bone. The jaws of birds are never armed with teeth, but simply covered with a horny sheath, which undergoes an immense number of modifications to suit it to the necessities of the different birds. Its structure and modifications will be referred to hereafter.

The vertebral column in birds exhibits the same division into separate regions as in the other Vertebrata; but as the exercise of the faculty of flight requires great solidity in the thoracic region, and the tail is very short, the only part of the spine that exhibits any flexibility is the neck. This is usually of considerable length, and consists of at least nine vertebræ; in the majority of birds, the number is from twelve to fifteen, and in some twenty, or even more. The bodies of these vertebræ are convex behind and concave in front, so that they are capable of great freedom of motion, and the transverse processes are very strong, and exhibit a foramen at their base, through which a portion of the arteries of the head and the main stems of the sympathetic nerve pass upwards to the head. From the peculiar conformation of the articulating surfaces of the vertebræ the neck is capable of describing very abrupt curves, and in most birds it is held more or less in the form of an S, this being the most favourable position for suddenly darting forward the head, a movement which is constantly employed by many of these animals in the capture of prey.

The dorsal vertebræ are usually eight or ten in number, and vary from six to ten or eleven. They are short and broad, firmly attached to each other, and not unfrequently anchylosed. They are furnished with spinous processes on their lower surface, which project into the cavity of the body, and serve to give support to the lungs. They have also dorsal spinous processes for the attachment of muscles, and transverse processes to which the ribs are articulated. The latter, which articulate both with the transverse processes and with the bodies of the vertebræ, are flat bones, which unite by a moveable articulation with a corresponding series of bones rising from each side of the sternum (the *sternal ribs*), which are analogous with the cartilages of the ribs in other animals. To give increased stability to this apparatus of ribs, each of them is furnished with a laminar process, which passes obliquely upwards and backwards, and is attached to the following rib (Fig. 103). In addition to these true ribs, which correspond in number with the dorsal vertebræ, there are frequently one or two false ribs in front, which do not reach the sternum, and the lumbar vertebræ are also occasionally furnished with ribs, which resemble the true ribs in structure, except that they want the laminar processes.

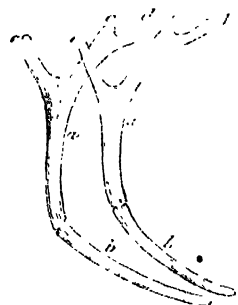


Fig. 103.—Ribs of the Golden Eagle.

*aa*, ribs; *bb*, sternal ribs; *cc*, articulating surfaces for the transverse processes; *dd*, heads of the ribs, articulating with the bodies of the vertebræ; *ee*, laminar processes.

The lumbar and sacral vertebræ, which vary in number from seven to twenty, are completely united, so as to form a single bony piece, the only indications of its compound nature being afforded by the foramina which exist in its upper surface for the passage of the nerves. With this elongated sacrum the pelvic arch is also amalgamated,

so that the apparatus to which the hind limbs are attached acquires all the solidity of a single bone. The tail is very short, and composed of from six to nine small vertebræ, which are capable of a certain amount of motion, and are furnished with strong transverse processes. The last vertebra is considerably larger than its fellows, of an oblong form, and set on in a direction nearly perpendicular to the axis of the body; it gives attachment to the muscles which move the feathers of the tail, and is, consequently, of great importance.

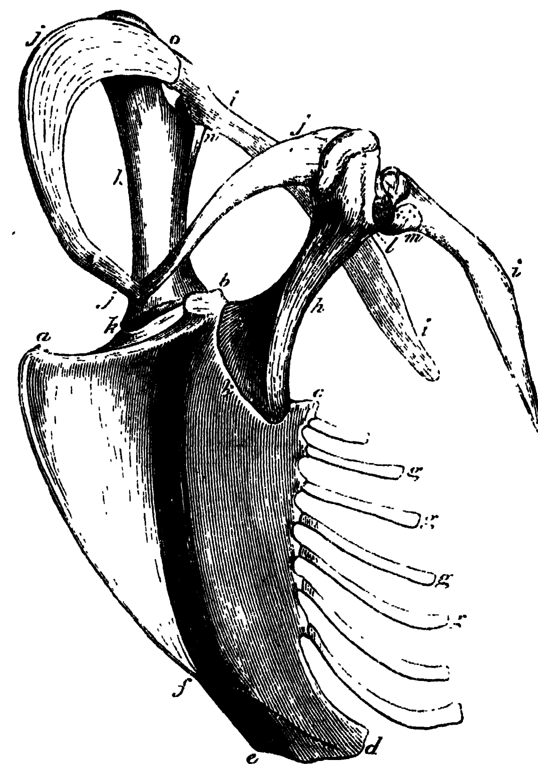



Fig. 104.—Sternal apparatus of the Golden Eagle.
*a b c d e f*, sternum; *g g g g*, sternal ribs; *h h*, coracoid bones; *i i*, scapulæ; *j j*, clavicles.

The sternum, which occupies the anterior part of the thorax, is of very large size in most birds, extending backwards under the greater part of the abdominal cavity. It forms a broad plate, concave on its internal, and convex on its outer surface, where it is also furnished with a very prominent keel, or ridge, to which the powerful muscles of the wings are attached, so that the greater or less development of this keel may be taken as a criterion of the power of flight of the bird to which it belonged. In the Ostriches, and other birds in which the wings are so small that they are quite useless for flight, the sternal keel is entirely wanting.

The upper part of the sternum also serves for the support of the bones of the scapular arch, which are very firmly united together, so as to afford a solid point of attachment for the anterior limbs. This arch consists of three bones on each side (Fig. 104), of which one, the *coracoid bone*, which is firmly articulated to a large pit in the anterior angle of the sternum, gives the principal support to the anterior member. At the superior extremity of the coracoid bone, which is the strongest of all the bones of the shoulder, there is an articulating surface, which assists in the formation of the cavity for the reception of the head of the humerus.

This is completed by a corresponding surface on the anterior extremity of the *scapula*, or shoulder-blade, which is also articulated at this part to the coracoid bone, and extends backwards along the dorsal surface of the ribs, close to the spine. The arch is completed by the clavicles, which are usually anchylosed at their extremity, so as to form a single V-shaped bone, which is commonly known as the *furculum*, or merry-thought. The angle of union of the two clavicles is also sometimes anchylosed to the anterior angle of the sternal keel; but in most birds it is only attached to this point by ligament. The upper extremities of the clavicles are articulated to the coracoid bones and scapulæ, which they assist in supporting against the action of the powerful muscles of the wings.

The bones of the anterior extremities are remarkably elongated to suit them for the important part which they have to perform in supporting the bird in the air, but in other respects there is no difficulty in recognizing them as modifications of the same parts which occur in all other Vertebrata (Fig. 105). The humerus, which articulates with the glenoid cavity of the shoulder, is a cylindrical bone of moderate length, but very stout. At its lower extremity it exhibits two articulating surfaces for the reception of the two bones of which the fore-arm is as usual composed. These bones, the radius and ulna, are much longer than the humerus; they are both of a cylindrical form and thickened at the extremities, but their size is very unequal, the ulna being much stouter than the radius, which is usually very slender. These are followed by two small, rounded bones (the *carpal* bones) forming the wrist-joint; and these again by two elongated bones, which are completely united at their extremities, and represent the bones of the hand (*metacarpals*) in man and other Vertebrata. At the base of the united metacarpal bones, there is another small bone, sometimes free, sometimes anchylosed, which represents the thumb, and gives support to the feathers of the pinion or bastard-wing; and they are followed by two short fingers, of which one consists of two or three phalanges, whilst the other never contains more than a single joint. The articulations of the principal bones possess great freedom of motion in certain directions, so that in repose the whole limb can be folded up in a very small compass, the bones taking a nearly parallel position (Fig. 100).

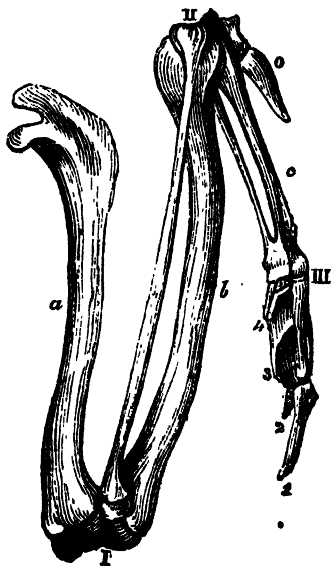


Fig. 105.—Bones of the Wing of the Jer-falcon. I, elbow-joint; II, wrist-joint; III, knuckle-joint; *a*, humerus; *b*, radius and ulna; *c*, metacarpus; *o*, rudimentary thumb; 1, 2, 3, 4, rudimentary phalanges of fingers.

The bones of the hinder extremities are always well developed; but, except in the Ostriches, the two sides of the pelvis are not united beneath. The bones of each side are, however, completely amalgamated with each other, and with the sacrum. The hinder limbs are composed of the usual bones. The femur, or thigh bone, is a

short, stout, cylindrical bone, articulating with the pelvis by a small rounded head, which is placed at right angles to the axis of the bone; it is completely concealed within the muscles of the body. The knee-joint is completed in front by a small *patella*, or knee-cap, and the shank, which is much longer than the thigh, is formed almost entirely by the tibia, the fibula being reduced to the form of a gradually attenuated bone, which is usually attached to the tibia. The tarsus is composed of a single cylindrical bone, of very variable length, which is generally covered only by a scaly skin, and rarely feathered. The foot consists of from two to four toes, composed of a variable number of joints; the great toe is usually directed backwards. The arrangement of the toes is, however, very variable in different groups of birds, to adapt the feet for walking, perching, or climbing; and these modifications will be referred to hereafter.

The muscles of birds are generally of a very firm nature and of a deep red colour; the great mass of muscles is devoted to the movement of the wings, and attached to the keel of the sternum. The sinews are beautifully white and glistening, and have a great tendency to become ossified in certain parts of the body. This is especially the case in the long tendons which pass down the tarsus from the flexor muscles of the toes, which are of particular importance to the bird in perching, as, from their passing over the back of the joint between the shank and tarsus, they are of course stretched by the bending of this joint, which is constantly observed to take place in a bird resting upon a perch; the toes are thus involuntarily made to grasp the object upon which the bird is sitting, and by this means it remains securely fixed, even when the voluntary action of the muscles is in abeyance, as during sleep.

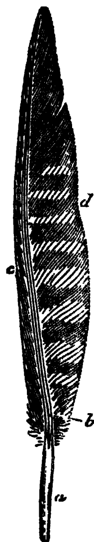


Fig. 106. Quill Feather. *a*, tube; *b*, shaft; *c*, *d*, webs.

The clothing of the skin in birds consists of the peculiar organs well known as *feathers*, which, although they agree in their nature and mode of development with the hairs of the Mammalia, are of a far more complicated structure. It is also to the great development of some of these dermal appendages, the strong quill feathers of the wing, that these animals are indebted for their power of flight; and the existence of similar strong feathers in the tail is also of great importance to them in directing their course through the air.

A perfect feather (Fig. 106) consists of the *shaft*, or central stem—which is tubular at the base, where it is inserted into the skin—and the *barbs*, or fibres, which form the *webs* on each side of the shaft. The basal portion of the shaft presents the appearance of a transparent, horny, cylindrical tube, narrowed at the extremity which is inserted in the skin. The upper portion, or true shaft, is always of much greater length than the tube, and tapers gradually to the extremity; it is flattened at the sides, more or less convex on the back, and the lower surface exhibits a strong longitudinal groove. It is composed of a white, elastic, spongy matter, which is covered by a thin horny sheath. The dorsal portion of this horny sheath envelops the whole of the base of the shaft, and becomes continuous with the tubular part of the feather. At the point where the complete horny tube commences, the feather usually gives rise to a small supplementary shaft, also furnished with barbs, which is denominated the *plumule*. This appendage is confined to the feathers composing the general plumage of the bird, and even on

these it is not always present; it is always wanting on the quills of the wings and tail.

The webs are composed of numerous barbs, or small fibres, arranged in a single series along each side of the shaft. These are slender prolongations of the outer horny coat of the shaft; they are inclined towards the apex of the feather, and are usually of a flattened form, slightly concave on one side and convex on the other, so that each barb fits closely into that immediately preceding it. Their margins are furnished with a series of minute filaments, called *barbules*, by which the adhesion of the barbs to each other is effected, thus giving a great degree of firmness to the web, and these are not unfrequently also edged with still smaller fibres, to which the name of *barbules* has been given. Towards the base of the shaft the barbs are generally of a loose texture, and more or less disunited, forming the warm substance well known as down; this modification of structure is more particularly observable in the feathers of the general plumage, in which the down often forms the greater part of the feather; the plumule is also a downy feather.

The two principal modifications of the feather are *quills* and *plumes*. The former are distinguished by the great stiffness of their shafts, which enables them to become the principal agents in aërial locomotion; they are confined to the wings and tail. The plumes constitute the general clothing of the body, and differ from the quills in the greater delicacy of their texture.

Besides the common feathers, the skin of many birds, and especially of the aquatic species in which the accessory plumules rarely exist, is covered with a thick coating of down, which consists of a multitude of small feathers of peculiar construction; each of these down feathers is composed of a very small soft tube imbedded in the skin, from the interior of which there rises a small tuft of soft filaments, without any central shaft. These filaments are very slender, and bear on each side a series of still more delicate filaments, which may be regarded as analogous to the barbules of the ordinary feathers. This downy coat fulfils the same office as the soft woolly fur of many quadrupeds, the ordinary feathers being analogous to the long smooth hair by which the fur of those animals is concealed. The skin also bears a good many hair-like appendages, which are usually scattered sparingly over its surface; they rise from a bulb which is imbedded in the skin, and usually indicate their relation to the ordinary feathers by the presence of a few minute barbs towards the apex.

The development of feathers takes place in small sacs of the corium, or true skin, which are at first completely closed, and which still continue to envelop the base of the full grown feather. From the bottom of this sac a small prominence arises, which is continued into the tube of the feather in the form of a vascular membrane, which, however, dries up when the feather is mature, and then constitutes the shrivelled skin which is seen in all quills, and commonly known as the pith.

Once or twice in the course of the year the whole plumage of the bird is renewed. In many cases the new clothing is very different from that which it replaces, and in birds inhabiting temperate and cold climates we can frequently distinguish a summer and winter dress. This circumstance has given rise to the formation of a considerable number of false species, as the appearance of the birds in these different states is often very dissimilar; and it is only by an accurate study of the living animals, which is of course almost impossible with many exotic birds, that such mistakes as these can be prevented or rectified. Another fertile source of similar errors is to be found in the difference which very commonly exists between the two sexes, a difference which is often so

great that without particular information derived from the observation of the birds in their native haunts, it would be impossible to refer the males and females to their proper partners; and the difficulty is still further increased by the fact, that the young of all birds in their first plumage differ more or less from their parents, and frequently only acquire their mature dress after the lapse of three or four years; the plumage undergoing a certain change at each moult. These circumstances undoubtedly throw great difficulties in the way of the student of Ornithology, and it is perhaps not much to be wondered at if we have sometimes half-a-dozen different names for different states of the same species; but it must also be confessed, that in this, as in other departments of Natural History, the desire to describe new species has often led to an unjustifiable multiplication of errors of this description.

In a zoological point of view the greatest importance attaches to the feathers of the wings and tail, to which different names have been given. The quills are inserted into all the bones of the wing, but the longest are those attached to the bones of the hand, and to these the name of *primaries* is given. The feathers supported by the fore-arm are denominated *secondaries*, and those attached to the humerus *tertiaries*. The thumb also bears a few quills, which form what is called the *alula* or bastard wing. These, and some other feathers to which particular names have been given, are shown in the annexed cut (Fig. 107). The base of the quills is covered by a series of large feathers called the *wing coverts*, which are also distinguished into *primary* and *secondary*. The feathers of the tail are furnished with numerous muscles, by which they can be spread out and folded up like a fan. Their bases are also covered both above and beneath by smaller feathers, which are called the *tail coverts*.




Fig. 107.—A, ear coverts; B, bastard wing; C D E, wing coverts; F, primaries; G, scapulars; H, secondaries; L, tail coverts.

It is impossible to conceive any covering more beautifully adapted to the peculiar wants of these creatures than that with which they are endowed by nature. All the feathers being directed backwards, the most rapid motion through the air only tends to press them more closely to the body, and the warm air,

confined amongst the inner downy fibres, is thus effectually prevented from escaping. In the aquatic birds the feathers are constantly lubricated by an oily secretion, which completely excludes the water. In the wings the quill feathers exhibit in the highest degree a union of the two qualities of lightness and strength, whilst by their arrangement they can be folded together into a very small compass.

The feathers usually cover the whole surface of the bird with the exception of the mandibles and feet, and even the latter are sometimes clothed with feathers, but in some cases different portions of the surface are naked, and covered only with a soft skin. These naked portions are usually confined to the head, where the skin often forms remarkable folds or wattles; but in some cases, as the Vultures, the whole neck is bare of feathers.

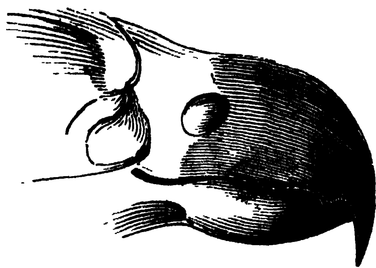


Fig. 108.—Beak of Jer-falcon.

The mandibles are always sheathed in a horny case, usually of a more or less conical form, on the sides of which the nostrils are commonly seen. In most birds the edges of this horny sheath are sharp and smooth, but in some they are more or less denticulated along the margins; the upper mandible is frequently hooked at the extremity, as in the predaceous birds (Fig. 108), where it serves for tearing the prey, or in the Parrots, which employ their beaks in climbing. The beak is sometimes of enormous size, as in the Toucans and Hornbills (Figs. 109 and 110); but in these it is of a light spongy texture, so that the birds exhibit far more activity than might be expected from the disproportionate bulk of their bills.



Fig. 109.—Beak of Toucan.

In the Ducks the bill is more or less flattened, and its texture is much softer than in other birds; it is furnished with numerous nerves, and thus serves as an organ of touch. In other birds, the simply conical form predominates, although the bill exhibits an almost infinite number of particular modifications, to suit the exigencies of different birds. At the base of the bill there is in many birds a circle of naked skin, which is called the *cere*; and in others, which capture insects on the wing, the hinder portion of the gape is bordered by long bristles (Fig. 111), which are of great service in preventing the escape of their insect prey.

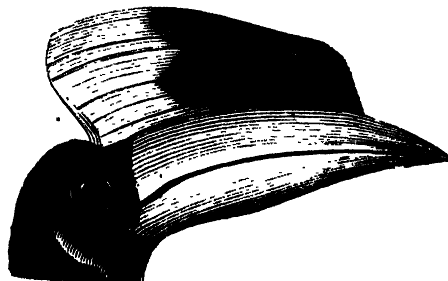


Fig. 110.—Beak of Hornbill.

The characters afforded by the form of the bill are of great importance in classification; and those derived from the structure of the feet and the arrangement of their scaly covering are perhaps equally valuable. In most birds the toes are four in number; and in the majority of these, three of the toes are directed forwards, whilst the fourth or great toe is turned backwards (Fig. 112). In some birds the posterior toe is wanting (Fig. 113); and in the Ostriches one of the others is also deficient, and the foot consists only of two toes In the Parrots, again, the outer toe is also turned backwards (Fig. 114), and the foot is divided into two pairs of toes, an arrangement which enables these birds to climb with great facility, their feet being applicable to many of the purposes of hands. In the Cuckoo and some other birds the outer toe is capable of being directed either backwards or forwards at the pleasure of the animal; and in some of the Swallows the whole of the toes are turned forwards. The water birds have the toes more or less united by a web, which is usually confined to the three anterior toes, but in some species also extends along the side of the foot to the great toe (Fig. 115).



Fig. 111. Head of Goatsucker.

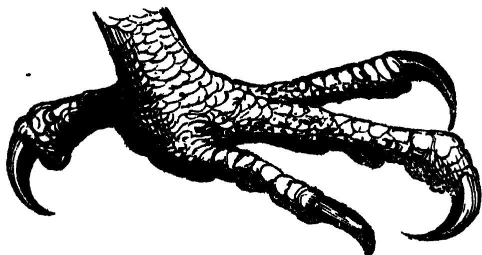


Fig. 112.—Foot of the Falcon.

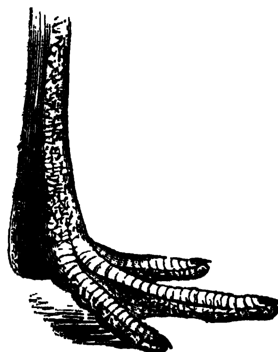


Fig. 113.—Foot of the Bustard.

The feet and tarsi are generally bare of feathers, and covered with a horny skin, which is sometimes simply granular, but usually more or less distinctly divided into horny plates, the form and arrangement of which afford very important characters for the classification of these animals. The toes are always terminated by claws, which vary greatly in their form according to the habits of the animals. In the predaceous birds they are very



Fig. 114.—Foot of the Parrot.

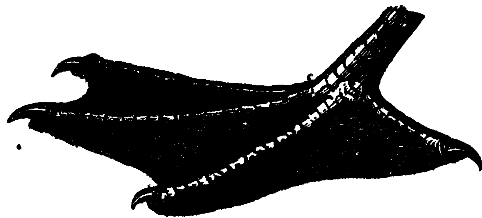


Fig. 115.—Foot of the Gannet.

long, strong, curved and acute, constituting the formidable weapons with which these creatures seize their prey; the harmless perching birds have long slender claws; and the scratching birds, such as the common fowl and its allies, are furnished with stout nails. The latter are also frequently armed with an accessory claw, attached to the back of the tarsus above the great toe (Fig. 116).

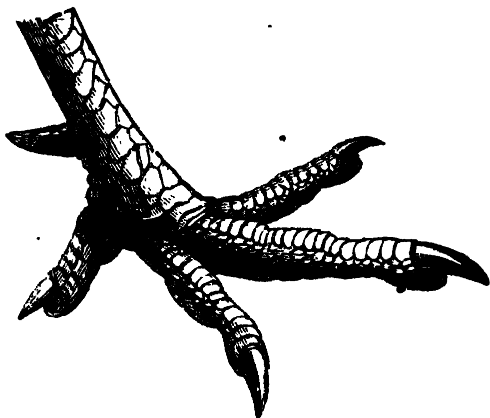


Fig. 116.—Foot of the Fowl.

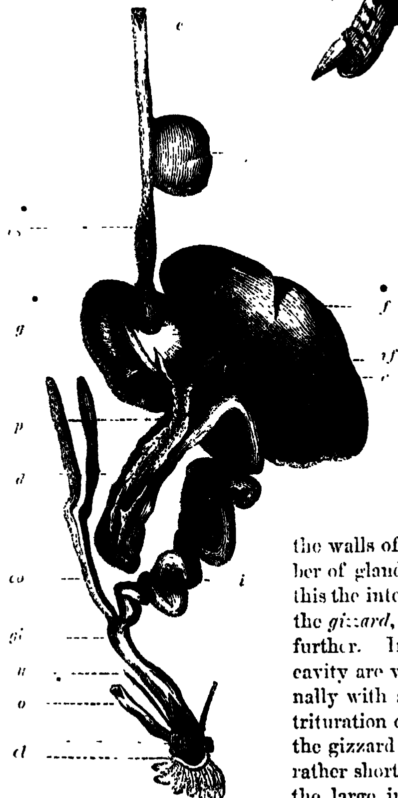



Fig. 117.—Digestive apparatus of common Fowl. *e*, œsophagus; *f*, crop; *vs*, ventriculus succenturiatus; *g*, gizzard; *p*, pancreas; *d*, duodenum; *co*, cœca; *gi*, large intestine; *u*, ureter; *o*, oviduct; *cl*, cloaca; *i*, small intestine; *f*, liver; *vf*, gall bladder; *c*, gall duct.

In the structure of the digestive organs, birds exhibit a great uniformity. The œsophagus, which is often very muscular, is usually dilated into a large sac, called the *crop*, at its entrance into the breast; this is abundantly supplied with glands, and acts as a sort of first stomach, in which the food receives a certain amount of preparation before being submitted to the action of the proper digestive organs. A little below the crop the narrow œsophagus is again slightly dilated, forming what is called the *ventriculus succenturiatus*, the walls of which are thick, and contain a great number of glands, which secrete the gastric juice. Below this the intestinal canal is enlarged into a third stomach, the *gizzard*, in which the process of digestion is carried further. In the granivorous birds the walls of this cavity are very thick and muscular, and clothed internally with a strong horny epithelium, serving for the trituration of the food; but in the predaceous species the gizzard is thin and membranous. The intestine is rather short, but usually exhibits several convolutions; the large intestine is always furnished with two cœca. The large intestine opens by a semicircular orifice into the cloaca, which also receives the orifices of the urinary and generative organs. The liver is of large size, and usually furnished with a gall-bladder. The pancreas is lodged in a sort of loop formed by the small intestine

immediately after quitting the gizzard. There are also large salivary glands in the neighbourhood of the mouth, which pour their secretion into that cavity.

The organs of circulation and respiration in birds present a marked advance upon those of Reptiles. They are not, however, separated from the abdominal cavity by a diaphragm. The heart consists of four distinctly separated cavities—two auricles, and two ventricles—so that the venous and arterial blood can never mix in that organ, and the whole of the blood returned from the different parts of the body passes through the lungs before being again driven into the systemic arteries. The blood is received from the veins of the body in the right auricle, from which it passes through a valvular opening into the right ventricle, and is thence driven into the lungs. From these organs it returns through the pulmonary veins into the left auricle, and passes thence into the ventricle of the same side, by the contraction of which it is driven into the aorta. This soon divides into two branches, which by their further subdivision give rise to the arteries of the body.

The lungs are of considerable size, and adhere to the ribs and inferior spinous processes of the vertebral column. They are red spongy organs, and exhibit several openings (usually four pairs, Fig. 118) on their surface, which lead into large air-sacs,

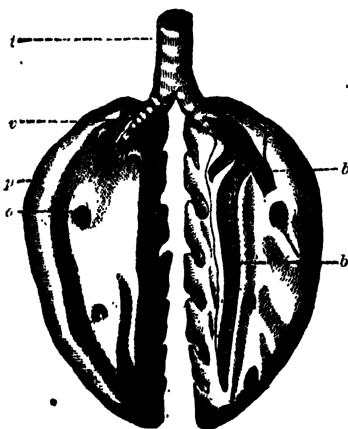


Fig. 118.—Lungs of the Apteryx.

*t*, trachea; *v*, pulmonary vessels; *p*, lung; *o*, bronchial orifices; *b b*, bronchial tube opened.

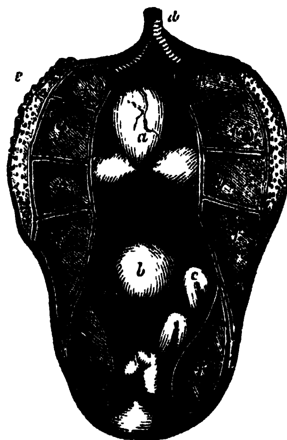


Fig. 119.—Lungs and air-sacs of the Ostrich.

*a*, heart; *b*, stomach; *c c*, intestines; *d*, trachea; *e*, lungs; *f f f*, air-sacs, with the apertures through which they communicate with the lungs.

hollowed out in the cellular tissue of the body (Fig. 119). These air-sacs are in communication with the cells in the interior of the bones, which thus receive a constant supply of air. The air thus penetrates to all parts of the body, so that respiration goes on with greater activity in birds than in any other Vertebrata, for a portion of the blood is constantly in contact with air when passing through the capillaries of the body as well as through those of the lungs. The consequence of this is that the blood attains a

higher temperature than even in the Mammalia; and as the clothing of birds is of a nature to prevent the dispersion of this heat, the temperature of their bodies is constantly very high.

The trachea opens into the œsophagus by a longitudinal slit a little behind the root of the tongue. It runs down the neck in the form of a single tube, usually composed of complete cartilaginous rings; and in some birds which have a loud cry, such as the wild Swan, it is convoluted, and received into a cavity of the front of the sternum. In general, however, it runs straight to the lungs, before entering which it divides into two branches. At this point there is usually a second larynx, furnished with an apparatus of muscles, which is the principal agent in the production of the well-known sounds emitted by many birds.*

The kidneys, which are frequently united, are situated in the posterior portion of the abdominal cavity close to the sacrum; their secretion is discharged directly through the ureters into the cloaca. In addition to the kidneys, there is another secretory organ situated on the surface of the tail; it produces a fatty secretion, which communicates a certain amount of greasiness to the feathers; and this is so great in the aquatic birds that their feathers are never wetted by immersion in water.

In the development of the nervous system, also, birds exhibit a considerable superiority over the reptiles. The brain is larger in proportion to the spinal marrow, and the hemispheres of the cerebrum or true brain are especially developed (Fig. 120). The cerebral hemispheres are smooth, and quite destitute of the convolutions which are generally observable on the surface of these parts in the Mammalia; and the great commissure which unites the hemispheres in the latter, known as the *corpus callosum*, is also wanting. The cerebellum is much larger than in the Reptiles, and distinctly grooved transversely; it consists almost entirely of the central portion; the hemispheres of the cerebellum, which in the Mammalia are always of considerable size, and often form the greater part of that organ, being here usually reduced to a comparatively rudimentary condition. The main stem of the sympathic nerve, as already stated, passes up to the brain through the lateral apertures of the cervical vertebræ.

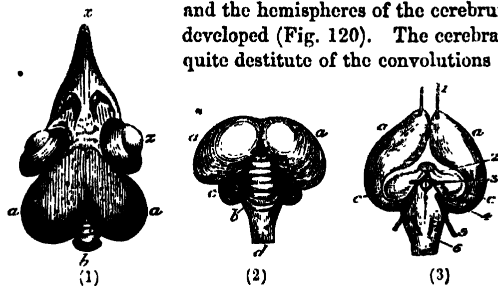


Fig. 120.—Brain of the Sparrow.

(1). From above—*a*, cerebral lobes; *b*, cerebellum; *x*, bill; *z*, eyes. (2). From behind—*a*, cerebral lobes; *b*, cerebellum; *c*, optic lobes; *d*, medulla oblongata. (3). From beneath—*a*, cerebral lobes; *c*, optic lobes; 1, 2, 3, 4, 5, 6, six pairs of cerebral nerves.

The organs of the senses are also usually present in a tolerably high state of development. The sense of smell, however, is but imperfect, the nasal cavity exhibits but few convolutions, and in some birds the external nasal apertures are either entirely wanting or reduced to a very small size. These orifices are generally placed on the sides of the bill, or quite at its base, where they are frequently surrounded by a naked

* The mechanism of the vocal organs in birds has already been described in the Treatise on Physiology. See Organic Nature, Vol. I., page 143.

skin; but in the wingless *Apteryx* of New Zealand the nostrils are situated at the extremity of the long bill.

The eyes of most birds are of large size, and the sense of sight appears to be possessed by these animals in a state of great perfection. The eyes are never concealed beneath the skin, as in some Reptiles; they possess but little power of motion, and, in some cases, are immoveably fixed in the orbits. They are furnished with two moveable eyelids, and with a nictitating membrane. The structure of the eye itself (Fig. 121) is remarkable; the eyeball is very large, but at its anterior portion it is narrowed into a sort of neck, the front of which supports the convex cornea. In this narrowed portion of the eyeball there is a ring of small bony pieces imbedded in the sclerotic coat.

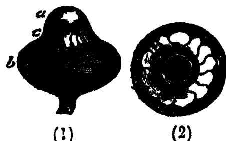



Fig. 121.—Eye of the Owl. (1) seen from the side; (2) from the front. *a*. cornea; *b*, sclerotica; *c*, bony plates.

The auditory apparatus is also well developed, and always opens externally on the sides of the head; but there is no external ear, the place of this organ being usually taken by a circle of feathers placed round the opening. The tympanic membrane is placed at the bottom of a very short and broad auditory canal; attached to its inner surface there is a single long ossicle. The tympanic cavity is of large size, and communicates with numerous cells in the bones of the skull, and also by a short Eustachian tube with the mouth. The labyrinth consists of a small vestibule and cochlea, accompanied by three semicircular canals.

The sense of taste, like that of smell, appears to be exercised very imperfectly by most birds. In a few, such as the Parrots, the tongue is soft and fleshy; but in the majority it is covered by a horny coat, and appears to be reduced to the condition of a mere accessory in the division of the food.

In their reproduction Birds are strictly oviparous, and even the phenomenon of ovo-viviparous propagation does not occur amongst them. The eggs are always inclosed in a hard shell, consisting of calcareous matter; and, unlike the animals of the preceding classes, Birds, instead of abandoning the hatching of their eggs and the development of their offspring to chance, almost invariably devote their whole attention, during the breeding season, to this important object, sitting constantly upon the eggs to communicate to them the degree of warmth necessary for the evolution of the embryo, and attending to the wants of their newly-hatched young, until the latter are in a condition to shift for themselves.

Most birds live in pairs during the breeding season, which usually occurs only once in the year; and both sexes generally take an equal part in the care of the young. They usually form a nest of some description for the reception of the eggs; this is composed of the most different materials, such as sticks, moss, wool, vegetable fibres, &c., and comparatively few are contented with a hole scratched in the ground for the performance of the work of incubation: in fact, in many instances, the work of these little architects must excite the admiration of every observer. The nests of different individuals of the same species are generally not only of the same form, but even composed nearly of the same materials; so that an observer, accustomed to the inspection of birds' nests, can generally tell at a glance the species to which a nest belongs. The number of eggs laid is also very uniform in each species.

In the structure and development of the egg, we find a great uniformity throughout

this class; and, as the phenomena in question have already been described in the article on Physiology (ORGANIC NATURE, Vol. I., p. 82), it will be unnecessary to devote any space to them in this place. We may, however, remark that the development of the embryo takes place here in precisely the same manner as in the Reptiles. Notwithstanding this general uniformity in the processes of reproduction, there is a remarkable difference in the condition of the young birds at the moment of hatching, and this has given rise to the division of the class into two great sections. In some, which usually reside upon the ground, where they form their nests and hatch their young, the latter are able to run about from the moment of their breaking the egg-shell, and the only care of the parents is devoted to protecting their offspring from danger, and leading them into those places where they are likely to meet with food. The others, which, in fact, constitute the majority of the class, pass more of their time in the air, and generally repose upon the trees, or in other elevated situations, where they also build their nests; and the young birds for some time after they are hatched remain in the nest in a comparatively helpless state, their parents bringing them food, and attending upon them most assiduously until their feathers are sufficiently grown to enable them to support themselves upon the wing.

Another remarkable phenomenon presented by this interesting class of animals, is the instinct which prompts many of them to change the place of their abode, in accordance with the season of the year. In some cases these migrations are of comparatively small extent, the birds moving only from one part of a country to the other, frequently for the sake of a supply of food; but many species, which are commonly known as birds of passage, perform long journeys twice in the year, visiting temperate, or even cold, climates during the summer, and quitting these at the approach of winter for regions which enjoy a more genial temperature during this period of the year. The Swallows, and many others of our small birds, are well-known examples of birds which visit the temperate regions of Europe, and remain in these countries to breed during the summer; and a considerable number of other species, including several of our aquatic birds, arrive in the temperate regions of Europe at the approach of winter, their summer residence and breeding places being situated far to the north. The winter quarters of our summer visitants appear to be principally the coasts of the Mediterranean, and especially the northern parts of Africa. In their long journeys to reach these countries, they are of course compelled to pass over a considerable expanse of sea; and before venturing upon this arduous portion of their voyage, they are frequently found collected in vast flocks upon promontories which project towards the place of their destination. On their arrival on the opposite shore, many species are so exhausted by their exertions that they may be taken by the hand.

**Divisions.**—We have already observed that the class of Birds falls into two great natural sections, in one of which the young are produced in such a condition that they are capable of moving about immediately on their quitting the egg; whilst, in the other series, the young remain in the nest until they are completely fledged, and are supplied with food by their parents until that time. The general habits of the adult animals are equally characteristic of these two sections: the birds belonging to the latter are generally distinguished by their great power of wing, which fits them especially for an aërial residence, whilst their feet are more particularly adapted for perching; those of the former series, on the contrary, are distinguished by their stronger feet, which adapt them more especially for walking upon the ground, and their wings are frequently weaker than in the opposite section, although many of the

species possess great power of flight. The names of *Autophagi* and *Insessores* have been proposed for these two sections, each of which includes several orders.*

The first section, that of the Autophagi, in which the young birds are capable of feeding themselves from the moment of leaving the egg, includes four orders; namely, the *Natatores*, or Swimmers, in which the legs are usually short, and the toes always furnished with a membrane; the *Grallatores*, or Wading Birds, which have the legs elongated, with the extremity of the tibiæ usually naked, and the toes free; the *Cursores*, or Runners, with rudimentary wings, and powerful cursorial legs; and the *Rasores*, or Gallinaceous Birds, with short legs, divided toes, adapted either for walking or perching, and well-developed wings.

The Insessorial section also includes four orders, of which the first, including the Pigeons, or *Columbæ*, is distinguished by the presence of a cartilaginous scale at the base of the beak, covering the nasal cavities, and exhibits considerable analogy with the Gallinaceous birds, especially in the structure of the feet. Of the three other orders, the *Scansores*, or Climbing Birds, are characterized by the structure of their feet, two of the toes being directed forwards, and two backwards; the *Passeres*, or Perchers, by their usually straight bills, and comparatively slender feet, of which three of the toes are turned forwards, and one backwards; and the *Raptores*, or Predaceous Birds, by their powerful hooked beaks, and strong talons armed with formidable claws.

### ORDER I.—NATATORES.

**General Characters.**—The most striking character of the *Natatores*, or Swimming Birds, is derived from the structure of the feet, which are always palmate, or furnished with webs between the toes. There are always three toes directed forwards, and these are usually united by a membrane to their extremities; but in some cases the membrane is deeply cleft, and the toes are occasionally quite free, and furnished with a distinct web on each side. The fourth toe is generally but little developed, and often entirely wanting; when present it is usually directed backwards, and the membrane is sometimes continued to it along the side of the foot (Fig. 115). These webbed feet are the principal agents by which these birds propel themselves through the water, upon the surface of which most of them pass a great portion of their time; and by the same means many species dive to a considerable distance below the surface in search of their food, which consists almost entirely of Fish, Mollusca, and other small aquatic animals. The feet are generally placed very far back, a position which is exceedingly favourable to their action in swimming and diving, but which renders the terrestrial progression of the Natatorial birds anything but elegant. In some instances the feet are situated quite at the hinder extremity of the body, which then assumes an upright position when on land.

The body is generally stout and heavy, and covered with a very thick, close, downy plumage, which the bird keeps constantly anointed with the greasy secretion of the caudal gland, so that it is completely waterproof. The wings exhibit a very great variety in their development. In the Penguins they are reduced to a rudimentary condition, destitute of quills, and covered with a scaly skin, forming flat, fin-like organs; whilst in some other species the wings are of vast size and power, and the birds pass nearly their whole lives in the air. Between these two extremes we meet with every intermediate degree of development. Those species which are endowed with

* These statements apply only to the majority of the birds in each section, as several of the *Autophagi* feed their young for a considerable time.

the greatest power of flight are usually incapable of diving, although they frequently take their prey by plunging suddenly into the water when on the wing.

The form of the bill is also very variable,—in some it is broad and flat, in others deep and compressed, and in others long and slender. The mandibles are sometimes sharp and smooth, sometimes furnished with denticulations or lamellæ at the margins. The texture of the bill also varies; but these differences will be referred to in characterizing the families.

Most of these birds live in societies, which are often excessively numerous, inhabiting high northern and southern latitudes. Many of them prefer rocky coasts, in the clefts and corners of which they lay their eggs, often on the bare rock, but generally selecting the most inaccessible situations. The nest is always of a very rude description; but some species have the instinct to attach their nests to aquatic plants in such a manner that, although it is securely anchored to one spot, it is capable of rising or falling, in accordance with any change that may take place in the level of the water.

**Divisions.**—The Natatorial birds are divided into six families. The *Alcidæ*, or Auks, forming the first of these, have the feet placed very far back, close to the hinder extremity of the body; the toes always united by a membrane, and the hinder toe either rudimentary or entirely wanting. The Alcidæ do not support themselves when on land merely upon the toes, as is the case with most other birds, but upon the whole lower surface of the tarsus, which is usually furnished with a sort of sole to adapt it for this purpose. The wings are very small, sometimes rudimentary and covered only with a scaly skin, sometimes covered with feathers and furnished with quills, so that the birds are capable of rising into the air, although their flight is by no means powerful. The beak is compressed and short, sometimes hooked at the tip; and the plumage is exceedingly thick and close.

In the species with rudimentary, fin-like wings, the scales with which the skin of those organs is covered, are really rudimentary feathers. These birds, which are well known to voyagers under the name of Penguins, form, with some authors, a distinct family, to which the name of *Spheniscidæ* has been given. They are found in vast quantities in the Antarctic seas, where they pass the greater portion of their time in the water, and appear rarely to stay any time on land, except during the breeding season. In the water they are exceedingly active, swimming and diving with the greatest facility; and making use of their little naked wings as fins when engaged in the latter operation. So completely is the water the natural home of the Penguins, that Mr. Darwin, in speaking of a species called the Jackass Penguin (*Eudyptes demersa*), says,—"When at sea, and fishing, it comes to the surface, for the purpose of breathing, with such a spring, and dives again so instantaneously, that I defy any one at first sight to be sure that it is not a fish leaping for sport." On shore, from the extremely backward position of their feet, the Penguins are only able to stand in a very upright attitude (Fig. 122); and in this position they may be seen in countless multitudes arranged in regular ranks along the barren shores which they frequent. When in motion on land, however, they employ their wings in place



Fig. 122.—Penguin (*Aptenodytes*).

of an anterior pair of legs; and by their assistance contrive to scuttle along so rapidly that, according to Mr. Darwin, when they are in motion amongst the tussocks of grass, they might readily be mistaken for quadrupeds. When disturbed in their resting places, these birds exhibit a bold and determined demeanour, fighting bravely with their beaks in their endeavours to reach the sea; and Sir James Clark Ross, when taking possession of Victoria land in the name of Her Majesty, found that the Penguins, the only inhabitants of that inhospitable region, were by no means disposed to submit quietly to their invaders, but attacked and pecked at them vigorously as they were "wading" through their ranks. Their numbers were so great in Possession Island where the ceremony of taking possession was gone through, that Sir James tells us that the Penguins "completely and densely covered the whole surface of the island, even to the summits of the hills." The females hatch their eggs by holding them between the thighs, and when threatened with danger move away, still retaining the eggs in this position. During the period of incubation, the male fishes for the female; and after the young are hatched, both parents are engaged for a time in procuring them food. The roosting-places of the Penguins, like those of some other marine birds, are covered with a deep bed of excrementitious matter, mixed with the bones of dead birds and feathers, which has been gradually accumulated during the long series of ages that these birds have been in undisputed possession of their rocky shores. This substance is a most valuable manure, which, under the name of *guano*, has lately been much imported into this country. The largest species of Penguin is the *Spheniscus Magellanicus*, or Great Magellanic Penguin, which measures about two feet in length, and sometimes weighs between thirty and forty pounds.

Of the Alcidæ in which the wings are constructed in the usual manner, some have these organs so small that they are as useless for the purpose of flight as those of the Penguins. Of these the Great Auk (*Alca impennis*), which has occasionally, although rarely, been taken on the coasts of the British islands, is an example. The usual length of this bird is from two feet to two feet and a-half. It has occurred on various parts of the British coasts, but principally about the northern islands, and its home appears to be in the seas of the Arctic regions. Even there, however, it appears to be now nearly extinct. In the water, like the Penguins, which it resembles in the shortness of its wings, the Great Auk is exceedingly active; and Mr. Bullock, when in the Orkneys, pursued a male bird "for several hours, in a six-oared boat, without being able to kill him; for though he frequently got near him, so expert was the bird in its natural element, that it appeared impossible to shoot him. The rapidity with which he pursued his course under water was almost incredible."—(*Montagu.*) This bird was afterwards killed, however, and is now in the British Museum.

Nearly allied to the preceding species is the common Razor Bill (*Utamania torda*), which, however, possesses wings of much greater proportionate size, the length of the bird being only seventeen or eighteen inches, whilst the wing, from the flexure of the wrist to the tip of the primaries, is from seven to eight inches, and consequently as long, or longer, than the corresponding part in the Great Auk. This bird is very abundant in the Arctic seas, and occurs on our coasts in considerable numbers in the autumn, passing gradually more and more towards the south as the winter advances. Mr. Yarrell mentions that it has been found on the coasts of Italy and Sicily.

The commonest of our British Alcidæ, the Puffin (*Fratercula arctica*, Fig. 123), is a summer visitant, arriving on our shores in the months of April and May, and quitting them for more southern regions about the middle of August. It is about a foot in

length, and has a singularly compressed bill, with three grooves on each side of each mandible; with this it often excavates deep burrows in the sandy ground near the coast, in which it lays and hatches a single white egg. When rabbit-warrens, as is often the case, approach sufficiently close to the sea-shore to suit the convenience of the Puffins, they have no hesitation in taking possession of them, and their strong bills enable them to drive out the original inhabitants with great ease. When captured, they bite and scratch very severely. It is found on all parts of the British coasts; and in some of the Scottish islands forms, with other water-fowl, a considerable portion of the food of the inhabitants; it is eaten fresh, or salted and dried for winter use. The Puffin also occurs in all the northern coasts of Europe, and on the eastern coast of North America. It flies, swims, and dives well.



Fig. 123.—The Puffin (*Fratercula arctica*).

The Guillemots (*Uria*) differ from the Auks and Puffins in their straight, pointed bills, but resemble them in the form of their bodies and in their general habits. They lay their eggs upon the bare surface of the ledges of rocks, and here the young ones remain for some time. It appears, however, that the young birds generally get into the water some time before they are full grown, and, according to some observers, the old birds carry them down upon their backs, whilst others say that they take them up by the skin of the neck, and thus convey them to the water. Mr. Yarrell states that the young Guillemots are constantly to be seen on the sea, so small that they could not possibly have descended by themselves from the lofty hiding places without destruction, and yet perfectly capable of taking care of themselves, swimming away and diving at the approach of a boat with the greatest ease. The Guillemots leave the rocks where they have passed the breeding season, at the end of August or the beginning of September, and do not return to them until April or May; the intervening period is passed on the open sea. They are found in all parts of the north of Europe and in the Arctic seas, extending as far south as the coasts of Holland and France, but rarely visiting the Mediterranean.

Nearly allied to the Guillemots is the Little Auk (*Mergulus alle*), the smallest bird of this family; it is distinguished from the rest by its short conical bill. It inhabits the Northern seas, and only visits our coasts during the winter. It resembles the Guillemots in its habits, and appears to be an oceanic species, only approaching the shores during the breeding season, or when compelled to do so by stress of weather. It is very abundant in the Arctic seas, occurring on the coasts of Greenland, Nova Zembla, and Spitzbergen. Colonel Sabine states, that on one occasion the Little Auk occurred in such quantities in Baffin's Bay and Davis's Straits during one of the voyages of discovery, that many hundreds were killed daily for the use of the ships' crews.

The *Colymbidæ* have the wings rather short, but still distinctly longer than in the

Alcidæ. The beak is rather long, conical, and pointed, with very small linear nostrils; the head is sometimes crested, or adorned with tufts of feathers; and the hinder toe, although small, is always distinct. The legs, as in the Alcidæ, are placed far back, so that the birds, when standing on the ground, assume a more or less erect position. The tarsi are much compressed, and the tibiæ almost entirely concealed beneath the skin of the body. The Colymbidæ inhabit the cold and temperate regions of the northern hemisphere, some of them residing in the neighbourhood of fresh waters, and only visiting the sea-coast, or the estuaries of rivers, when a severe winter drives them from their accustomed haunts; others are exclusively marine. They feed upon Fish, Mollusca, Insects, and Crustacea. In their habits these birds present a considerable resemblance to many of the Alcidæ; their flight is swift, but not long-continued, and they swim and dive with the greatest facility.

This family may be divided into two very distinct sections, in accordance with the structure of the foot. In the Grebes (*Podicipinæ*), the toes are not united by a membrane except close to the base, the remainder of the membrane taking the form of broad lobes surrounding each toe separately (Fig. 124). These birds, of which five species occur in our country, are generally found in the vicinity of fresh water, although they occasionally visit the sea, and often frequent the mouths of rivers. They are rarely seen on land, and then always keep close to the water's edge, so that when alarmed they may make their escape into their favourite element, into which they dive with so little disturbance as almost always to elude observation, unless they have been previously noticed. The head is often adorned with horn-like tufts, or surrounded by a ruff of feathers; the ventral surface is always of a beautiful silky white colour, and the plumage of this part is greatly admired for making muffs, and for trimming articles of winter dress. It is a remarkable circumstance that numerous feathers are always found in the stomachs of these birds, and these are generally their own feathers or those of other Grebes; the object of this provision is unknown, but it has been supposed that the feathers assist digestion in some way. They form a large nest, composed of rushes, sedges, reeds, and other vegetable matters, amongst the reeds and sedges which border the waters frequented by them; the number of eggs varies from three to seven or eight, according to the species. The young soon take to the water.

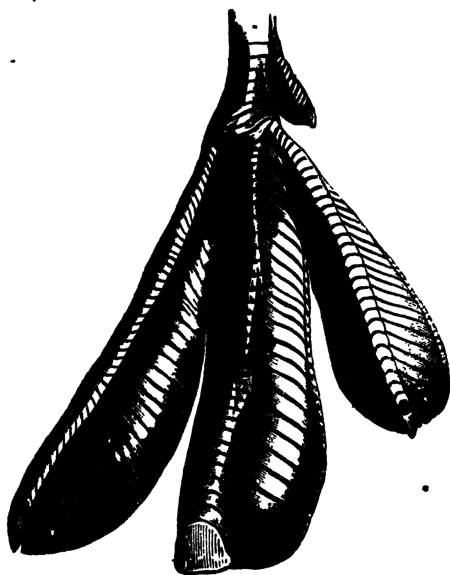


Fig 124.—Foot of Grebe (*Podiceps*).

The commonest of the British species is the Little Grebe, or Dabchick (*Podiceps*

*minor*, Fig. 125), a small bird of nine or ten inches in length, which is found abundantly in most parts of the country, about lakes and fish ponds. This little bird is exceedingly active in the water, swimming and diving with great ease, and remaining submerged for a considerable time; it progresses under water with great rapidity by the aid of both wings and feet: the larger Grebes do not appear to make use of their wings in this manner. Some birds nearly allied to the Grebes are found in tropical Africa and South America. Mr. G. R. Gray has established a third sub-family (*Heliornina*) for their reception.



Fig. 125.—Little Grebe, or Dabchick (*Podiceps minor*).

The *Colymbinæ*, or Divers, which have the three anterior toes completely united by a membrane, closely resemble the Grebes in their general appearance; but they are all inhabitants of the coast, and seek their food in the salt water. They are much larger birds than the Grebes, measuring usually between two feet and a-half and three feet in length, and are essentially inhabitants of the high northern latitudes, visiting our shores in the autumn, remaining through the winter, and quitting us in the spring to seek their northern breeding stations. A good many, however, remain to breed on the coasts and lakes of the Highlands and Islands of Scotland, forming a neat nest of vegetable materials on the beach or amongst the herbage of the shore; they lay two or three eggs, and the young take to the water soon after they are hatched. They fly rapidly, although their wings are very small in comparison to the size of their bodies, and exhibit the greatest activity in the water, swimming swiftly either upon the surface or with the whole of the body submerged, and diving and progressing under water with great ease. The Great Northern Diver (*Colymbus glacialis*, Fig. 126), which is one of the finest species, moves through the water with a speed equal to or exceeding that of a four-oared boat; and as it dives immediately on observing any cause for alarm, and rises again perhaps a quarter of a mile from the spot where it went



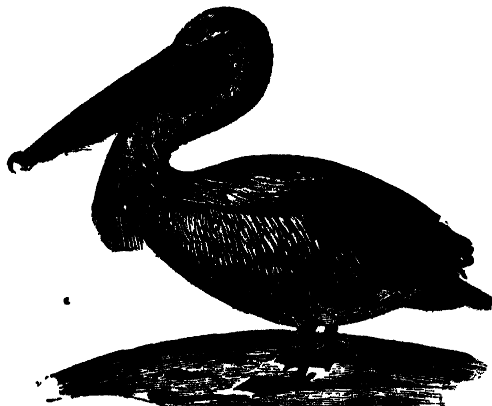
Fig. 126.—Great Northern Diver (*Colymbus glacialis*).

down, specimens are by no means easily procured. The other Divers appear to be equally active in the water, but on shore they are exceedingly helpless, and scarcely able to stand; when in motion on land, they rest upon their bellies, and push themselves along with the feet.

The Divers are followed by the interesting family of the *Pelecanidæ*, of which the essential character consists in the peculiar formation of the foot, the hinder toe being directed more or less inwards, and united by a web with the innermost of the three anterior toes (Fig. 115). The head is generally of moderate size, and supported upon a long slender neck; the bill is usually very long, rather slender, strongly keeled and pointed, or the upper mandible is terminated by a more or less hooked point (*unguis*). The branches of the lower mandible are only united close to the tip; and the skin which closes the space left between them is frequently dilated into a large pouch, which serves as a receptacle for the prey. The œsophagus, which is very large, is sometimes employed in the same manner. There is generally a patch of naked skin surrounding the eyes and the base of the bill, and the nostrils are very small and linear, or entirely absent. The feet are short and stout, placed towards the middle of the body, and the wings are long and powerful.

In their habits the Pelecanidæ exhibit considerable diversity, but they are all voracious birds, feeding entirely upon fishes, which they capture in various ways. They form a rude nest, sometimes on rocks close to the water, sometimes on trees at a considerable distance from it, and the young usually remain in the nest until they are capable of flight.

This family includes several very interesting birds, amongst which the best known are the typical Pelicans (Fig. 127), of which several species are found in different parts of the world. The Pelicans are large birds, the common species measuring from five to six feet in length, with an expanse of wing of from twelve to thirteen feet. They live indifferently on the banks of rivers and lakes and on the sea shores, generally in small flocks; and, according to Lesson, do not go to any very great distance from the shore. They swim and fly well, and, like the other species of this family and a few Ducks, are able to perch upon trees. The skin beneath the lower mandible is dilated into a large pouch, in which the fish are stored when captured; from this the food passes gradually into the œsophagus, as the process of digestion goes on. When fishing, the Pelicans fly over the water at a height of from twenty to forty feet, until they see a fish near enough to the surface, when they immediately dart down upon it with the most unerring certainty, store it away in the pouch, and proceed in search of more.


Fig. 127.—Pelican (*Pelecanus onocrotalus*).

The common Pelican has a delicate white plumage, more or less tinged with rose

colour; the first quill feathers of the wings are black. The upper mandible is bluish, tinged with yellow and red, and with the terminal hook bright red, and the pouch is yellow. This bird is found in the east of Europe, in Asia and Africa, occasionally wandering as far west as Germany, but never reaching this country. It forms a nest on the ground with sedges and grass, usually close to the water, and lays two or three white eggs. The young, when hatched, are fed by the parents from the gular pouch; and it is said that the male brings food to the female in the same manner, when the latter is engaged in incubation. In feeding their young, the Pelicans are said to press the pouch against the breast to assist in the disgorgement of the prey; and it is supposed that the contrast of the red tip of the bill to the snowy feathers of the breast, when the birds are thus engaged, must have given rise to the poetical notion which prevailed amongst the ancients, that the female Pelican nourished her young with her blood.

Nearly allied to the Pelicans are the Cormorants (*Phalacrocorax*), in which the bill is about the length of the head, straight and compressed, with the tip of the upper mandible hooked; the lower mandible is not furnished with a pouch, but the throat is capable of considerable dilatation. The base of the bill is surrounded by a naked skin, and the nostrils, as in the Pelicans, are scarcely perceptible. Several species of Cormorants are known, and they are generally distributed over the face of the globe. They are usually found in the neighbourhood of fresh waters, and feed upon Mollusca and Fishes, especially Eels, which they pursue under water with the greatest activity. They fly well, and often perch and make their nests on trees; but the nest is also frequently constructed on the ground or in the holes of rocks, according to the situations inhabited by the birds. When fishing, they often rise to the surface with the fish across the bill, throw it up into the air, and catch it again with the head foremost, so as to swallow it with greater facility. According to Mr. Waterton, the struggle between a Cormorant and a large Eel often lasts a considerable time before the bird can dispose comfortably of its prey. After the Eel has been got down for the first time, it frequently struggles violently to release itself from its disagreeable quarters, and continues to wriggle up backwards until a considerable portion of its tail is visible at the Cormorant's mouth, and this process may be repeated two or three times before the victim becomes so exhausted as to submit quietly to its fate. In some cases, however, it appears that when the Cormorant finds his prey is so large as to threaten to be troublesome, he takes the precaution to disable it, by taking it to the shore and beating it about with his bill.

The commonest European species is the *Phalacrocorax carbo*, which is found not only in Europe but in most of the northern parts of both hemispheres. It measures about three feet in length, and is of a blackish colour, more or less tinged with green, and the top of the head is furnished with a crest during the breeding season. Two or three other species are found in Europe.

Of the exotic species, the most remarkable is the Fishing Cormorant (*Phalacrocorax sinensis*), an inhabitant of China, where it is regularly trained and employed in fishing. Mr. Fortune, who saw them frequently engaged in this manner during his travels in the interior of China, says that their docility is so remarkable, that had he not witnessed their proceedings he would have had great difficulty in believing the statements of previous authors. They are taken out in small boats, each with a string tied round his neck to prevent his swallowing the fish when caught; and on receiving the word of command from their masters, immediately quit the boats and scatter themselves over the surface of the water, looking out for prey. The moment they perceive a fish below

them they dive down upon it, and, on rising again with their prey, they bring it to their masters with the docility of a dog, allow themselves to be dragged in, disgorge the fish, and then return to their occupation. "What is more wonderful still," adds Mr. Fortune, "if one of the Cormorants gets hold of a fish of large size, so large that he would have some difficulty in taking it to the boat, some of the others, seeing his dilemma, hasten to his assistance, and with their efforts united capture the animal and haul him off to the boat." Occasionally one of the birds will swim about without attending to its business; the fishermen then strike the water near it with a long bamboo used for propelling the boat, and call out to it in an angry tone, when the Cormorant, "like the truant schoolboy who neglects his lessons and is found out, gives up his play and resumes his labours." They fish for about seven hours daily, for seven or eight months in the year—namely, from October to May; they do not fish during the summer months. At five o'clock in the afternoon, when they cease fishing and come on shore, each bird receives about half a pound of fish and some pulse jelly, but during the day they are, of course, not fed. It appears that in some parts of China there are large establishments for breeding and training these birds. They begin to lay when about three years old; the eggs are hatched by hens, and the young, when excluded, are put upon cotton and fed with eels' blood for five days. At the end of this period they are fed with finely-chopped eels. It is interesting to see the instincts of a bird which, in a state of nature, is so exceedingly destructive, thus rendered subservient to the convenience of mankind; and it seems probable that our European species might be rendered equally docile—in fact, several instances are on record of the Great English Cormorant (*P. carbo*) having been trained to fish, but this has been only done for amusement.

Amongst the most remarkable birds of this family are the Frigate birds (*Tachypetes*, Fig. 128), which are distinguished by the immense length and power of their wings.



Fig. 128.—Frigate bird (*Tachypetes Aquilas*).

The tail is long and forked, the feet small, with the webs deeply notched, and both the mandibles are curved downwards at the tip. The immense extent of wing possessed by these birds (they are said sometimes to stretch from ten to twelve feet) gives them an extraordinary power of flight; and they not only dart through the air with great velocity, but fly to an immense distance from any land. They are exceedingly abun-

dant on the coasts of tropical America, where they may be seen sailing along at a considerable height above the surface of the waves, and darting down with the rapidity of lightning upon any fish that may come within reach. They also frequently attack other marine birds with such violence that they are glad to yield their prey to their active assailant, and make their escape. The Frigate birds are said to build in trees, and to lay one or two eggs.

The Gannets (*Sula*) resemble the Cormorants in their general form and in their voracity; but the upper mandible is much less curved at the apex, and the edges of both mandibles are finely denticulated. The face and throat are naked, the nostrils concealed, and the claw of the middle toe is pectinated. The common Gannet, Soland Goose, or Booby (*Sula Bassana*), is found in abundance on many parts of our island, especially on the western coasts; they congregate in vast numbers in particular places during the breeding season. On the eastern coast of Britain, their principal breeding station is the Bass Rock, in the Firth of Forth, their vast abundance upon which has given rise to the specific name. The name of Booby has been applied to them from the ease with which they may be approached, and even captured, especially when sitting.

The Gannets rarely swim much, and are quite incapable of diving. They take the fishes of which their prey consists by flying over the surface of the sea, and plunging suddenly down upon any that come within sight. They are constant attendants upon the shoals of herrings and pilchards, and, by their movements, often give the fishermen notice of the approach of these fishes, and of the direction in which they are proceeding. They form a nest with grass and sea-weeds upon the rocks, and lay a single egg. The young birds are taken in considerable numbers, and sold for food. The average number taken annually from the Bass Rock is from fifteen to sixteen hundred, and these are sold at from ninepence to a shilling each. The young birds are covered with a beautiful white down, which is said to be quite equal to swan's-down for the manufacture of tippets, &c. The adult Gannets attain a length of nearly three feet, but they are not used for food, and their capture is undertaken solely for the sake of the feathers. They are frequently taken by laying a herring upon a board, and dragging this along behind a boat; the Gannets, seeing the fish, plunge down upon it, and either break their necks by the shock, or strike their bills fairly through the board.

The preceding species all belong to the typical sub-family of the *Pelecaninæ;* but there are two other groups, each containing only a single genus, which have also been regarded as forming sub-families. In one of these, the Darters (*Plotinæ*), the general form of the body and feet resembles that of the Cormorants; but the head is smaller, and supported upon a very long slender neck, and the beak is perfectly straight and pointed, with the edges of the mandibles denticulated. The appearance of these birds is so singular, that some of the old voyagers regarded them as anomalous creatures, partaking of the nature of the Snake and the Duck; and the Hottentots are said by Lesson to give them the name of *Schlanghals-vogel*, or *Snake-necked birds*. They are found in the warmer parts of the world, principally in America and Africa, where they haunt the



Fig. 129.—Darter (*Plotus*).

margins of rivers and lakes, perching upon the trees, or flying over the surface until a fish comes in sight, when they immediately plunge down upon it, and rarely miss their aim. When swimming, the body is generally concealed under water, and sometimes only the head is visible. Their favourite position is upon the branches of trees overhanging the water, and when disturbed they are said to glide into the water so silently that the agitation of the water is not greater than would be produced by an eel. The Darters, like several other birds of this family, are said to nidificate in trees.

The Tropic birds (*Phaëtoninæ*), form another small group allied to the preceding. They are distinguished from the other Pelecanidæ by having the face clothed with feathers, and by the presence of a pair of long feathers, resembling straws, in the tail, whence the name of *Paille-en-queue*, or *Straw-tail*, given to these birds by the French. The Tropic birds have very small feet and long wings. They are endowed with great power of flight, and are frequently met with at considerable distances from land. They live, indeed, almost entirely upon the wing, but are said to return to roost on shore every night. They are confined almost entirely between the tropics; and so rarely are they seen beyond those limits, that their appearance is regarded by sailors as a certain indication of their approach to the tropical zone. The Phaëtoninæ are small birds, none of them exceeding the size of a Pigeon; they feed entirely upon fish, and make their nests amongst the rocks of the sea-shore. The long feathers of the tail are employed for ornamental purposes in most of the South Sea Islands.

The *Laridæ*, or Gulls, have the wings also of large size, and pass the greater part of their time in the air. The feet are usually rather small, furnished with three anterior toes, united by a membrane and a free hinder toe. The beak is of variable form, generally compressed, and the nostrils are linear or oblong. The Laridæ are active, noisy birds; most of them feed upon small fish, which they capture whilst skimming over the surface of the water. They are very buoyant on the water, but swim little, and are incapable of diving. They also form three sub-families. The Terns (*Sterninæ*) have the beak long, nearly straight, and pointed, the tarsi short, and the tail more or less forked; the latter character, coupled with their small size and constant activity on the wing, has obtained for them the name of Sea Swallows. The species are tolerably numerous, and live in all parts of the world. They generally collect in numerous bands, and feed principally upon small Fishes, Mollusca and Crustacea; but some species, such as the *Sterna anglica*, capture insects upon the wing, thus presenting as close a resemblance in their habits as in their form to the Swallows. The species which feed upon insects appear to frequent fresh-water lakes and marshes, and many of them are found on the vast marshes of Hungary and other inland countries.

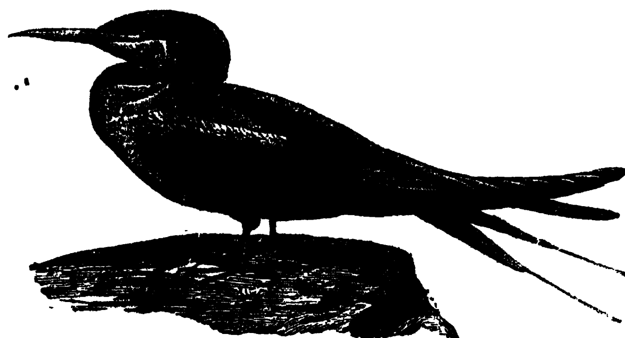
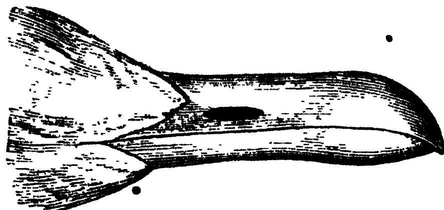


Fig. 130.—Sea Swallow (*Sterna hirundo*).

They make no nests, but the females lay their eggs, from two to four in number, upon the bare ground, or on the ledges of rocks; they exhibit great attachment to their young, and defend them with such courage as often to baffle birds of prey in their attempts to carry off any of the brood. About a dozen species occur in Britain, but they are only summer visitors, arriving on our coasts in the spring and quitting them again in the autumn for more genial climates.

A second sub-family (the *Rhynchopsinæ*) is formed by the remarkable genus *Rhynchops*, the species of which are found principally on the coast of both sides of the American continent. The beak in these birds is long, straight, and much compressed, in the form of the blade of a knife, the upper mandible being much shorter than the lower; the legs are slender, the wings very long, and the tail forked. The peculiar form of the beak, and the manner in which it is employed, have obtained for these birds the names of Shearwaters and Skimmers from the inhabitants of the United States; they skim along the surface of the ocean by means of their long and powerful wings, every now and then dipping the end of the elongated lower mandible into the water in search of the small Fishes and Crustacea, upon which they feed. According to Lesson, who observed these birds on the coast of Chili, they make another most ingenious use of their singular beaks. The flat, sandy shores of that country contain an abundance of bivalve Mollusca, of the genus *Mactra*, which are left nearly dry by the retreat of the tide. The Shearwaters watch until the Mollusca thus exposed open their valves a little, and then insert the extremity of the knife-like bill into the aperture; the Mactra, of course, closes its shell in alarm at this intrusion, when the bird drags his victim from the sand, and by knocking the shell upon the beach, soon drives his beak through the ligament, opens the shell, and feeds at his leisure upon the unfortunate inhabitant. The common Shearwater (*Rhynchops nigra*) is about nineteen inches in length; but its enormous wings extend upwards of forty inches, and, as might be expected from this circumstance, its power of flight is very great. Like the Terns, which they resemble in their general habits, the Shearwaters make no nest, but lay their eggs in a hollow of the sand; and the young, when hatched, are attended to with great care by the parents.

The sub-family of the Gulls (*Larinæ*), including the birds commonly known as Gulls, Sea-mews, &c., is distinguished from the Terns by the more robust and arched form of the beak (Fig. 131), which is always more or less convex above, and often strongly hooked at the tip. These birds are found in great abundance upon almost all shores, feeding upon Fishes, Crustacea, and Mollusca, which they capture alive, and not unfrequently condescending to make a meal upon the carcases of Whales and Seals which may be floating in their neighbourhood; in fact, one species, the Ivory Gull (*Pagophila eburnea*), which is abundant on the coasts of Greenland, has received the name of the Whale Gull, from its habit of feeding upon the dead bodies of Cetacea.

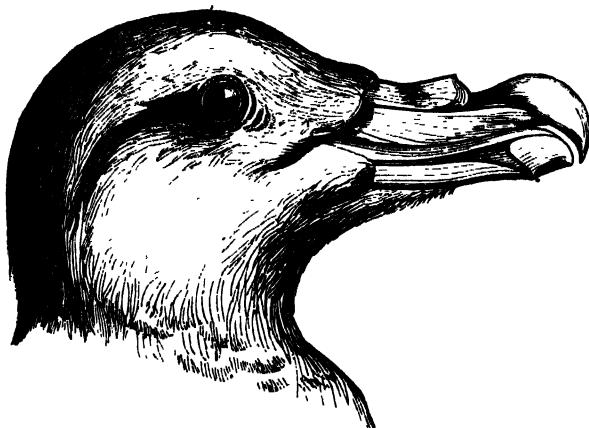

Fig. 131.—Beak of Gull.

They are exceedingly voracious birds, skimming constantly over the surface of the waves in search of their finny prey, and often following the shoals of fish to great

distances. The species of the genus *Lestris*, however, have the remarkable habit of accompanying the other Gulls and Terns when fishing, attacking them and compelling them to disgorge a portion of their prey, which the robber seizes before it reaches the water. These birds are endowed with a great power of flight, and their toes are armed with strong curved claws, although it does not appear that they seize the birds that they attack as above described. Some of the species often wander to a considerable distance inland, especially during stormy weather; and the smaller species not unfrequently visit ploughed fields, for the purpose of picking up worms and the larvæ of insects.

The Gulls generally congregate in vast numbers at their breeding-places, which are generally rocky headlands or islands. They make a rude nest, and lay from two to four eggs. The British species are rather numerous, but several of them only appear to visit our coast during the breeding season; whilst others, which breed in the high northern latitudes, are seen on the British coasts in the winter. A few remain here all the year round.

In the fifth family of the Natatorial birds, the *Procellaridæ*, including the Petrels and their allies, the general form of the body resembles that of the Gulls; but the feet are destitute of the hinder toe, and the structure of the beak is very different. The tip of the upper mandible is convex and strongly hooked, and the lower mandible is truncated at the apex; the apical portion of both mandibles being distinctly separated from the basal portion. The structure of the nostrils is also very peculiar; they are produced into tubes, more or less united together, and lying upon the dorsal surface of the upper mandible (Fig. 132).


Fig. 132.—Head of the Fulmar (*Fulmarus glacialis*).

In their habits, the Procellaridæ present a considerable resemblance to some of the Gulls; but they are more strictly oceanic, passing nearly their whole lives in skimming over the surface of the waves, and often appearing to delight in very rough water, from which circumstance they have long been regarded by sailors as the harbingers of a storm. Many of the species, in fact, appear scarcely ever to visit the shore, except for the purpose of laying their eggs and hatching their young; and for this purpose they generally select rocky shores, where they deposit their eggs upon the bare rock, without constructing any nest.

The most remarkable species is the Albatross (*Diomedea exulans*), a large bird which is found in considerable numbers in the vast expanse of ocean which lies to the south

of the Cape of Good Hope. Supported upon its enormous wings, which measure as much as fifteen feet in extent, the Albatross sails almost constantly over this stormy sea, occasionally plunging into the waves to seize the fishes which constitute its nourishment. They are exceedingly voracious, and it is said that they will even attack sailors, who may happen to fall overboard in places where they abound, if not immediately rescued by their comrades. It was long supposed that the Albatrosses were peculiar to the southern hemisphere, but a species has been found in considerable numbers in the North Pacific Ocean, about Behring's Straits, in pursuit of the vast shoals of fish which occur in those regions; it appears certain, however, that they seldom if ever approach the tropics.

Of the true Petrels (*Procellarinæ*), the largest is the Giant Petrel (*Ossifragus giganteus*), which inhabits the tempestuous seas to the south of Cape Horn, and, according to Lesson, measures about twenty-eight inches in length, and fifty-six in expanse of wing;—at a distance it may readily be mistaken for the Albatross. But the birds commonly known as Petrels, the Storm Birds, and Mother Carey's Chickens of the sailors, generally present a complete contrast to these giants of the order, some of them being the smallest of Natatorial birds; the oldest known species, the *Procellaria pelagica*, measures only six inches in length. These birds are generally regarded with abhorrence by sailors, who regard their appearance as the certain precursor of bad weather; and it is said that they always collect and utter their peculiar note on the approach of a storm. The name of *petrel*, applied to them, has a somewhat singular derivation. They have been said to run upon the surface of the waves with their wings closed, and this supposed faculty having been compared with St. Peter's miraculous walking upon the Sea of Genesareth, a diminutive of the apostle's name was applied to the bird. The Stormy Petrels feed upon Mollusca and Crustacea, and upon any small particles of nutritive matter which they may pick up when skimming over the surface of the waves. It is probable that their unwelcome appearance in the neighbourhood of vessels may be caused, to a great extent, by the attraction of the refuse which is commonly thrown overboard so plentifully. The stomach is generally filled with an oily matter; and when the birds are seized, they discharge this—sometimes, according to some observers, squirting it through the nostrils. They breed in the crevices of rocks, or in holes of the shore, the female laying a single white egg.

The Fulmar (*Fulmarus glacialis*), another British species of this family, is especially abundant in the Arctic seas, where it is a close attendant upon the whale fishers, snapping up any morsels of blubber that may fall into the water, and in its avidity for this tempting fare, it often approaches so closely to the men engaged in cutting away the blubber, as to be easily knocked on the head with a boat-hook, or even taken by the hand. These birds breed in one spot on the British coasts, the island of St. Kilda, where they are of great importance to the inhabitants, who not only eat the flesh and the eggs, but also collect the oil vomited by the birds when seized, and boil down the young birds for the sake of the fat yielded by them. The oil is burnt in lamps, and is also regarded as possessed of valuable medicinal properties. As the birds make their nests only on the ledges of nearly perpendicular rocks, their pursuit is a matter of great danger, the fowler being lowered by a rope from the top of the precipice.

The great family of the *Anatidæ*, which closes the order Natatores, is readily distinguishable from the preceding families by the structure of the bill. This organ is

usually of a flattened form, covered with a soft skin, and furnished at the edges with a series of lamellæ, which serve to sift or strain the mud in which these birds generally seek for their food (Fig. 133). The feet are furnished with four toes, of which three are directed forwards, and united by a web, whilst the fourth is directed backwards,

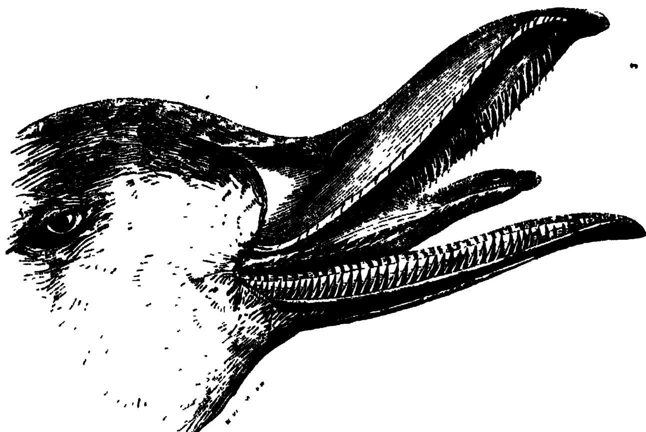


Fig. 133.—Head of Wild Duck (*Anas Boschas*), showing the lamellæ of the bill.

usually of small size, and quite free. The tongue is large and fleshy, the œsophagus narrow, and the gizzard strong and muscular, adapted for the trituration of the food, which in these birds is usually more or less of a vegetable nature. The trachea, in the males, is variously enlarged or twisted at its lower part, and the different modifications of this organ are often of great importance in the determination of the species. The wings are of moderate size, and the birds generally possess considerable power of flight, although in this respect they by no means equal those of the three preceding families.

The birds of this family, which, from its including the only domesticated species of the Natatorial order, must be regarded as of the greatest importance to man, are generally inhabitants of the fresh waters, and, for the most part, prefer ponds and shallow lakes, in which they can investigate the bottom with their peculiar bills without actually diving beneath the surface. Their food generally consists of Worms, Mollusca, and aquatic Insects, which they separate from the mud by the agency of the lamellæ at the margins of the bill; but most of them also feed upon seeds, fruits, and other vegetable substances. The family contains a great number of species, and has been divided into several sub-families, of which the following are the principal.

The Mergansers (*Merginæ*) have an attenuated and nearly cylindrical bill, the upper mandible of which is terminated by a strongly-hooked nail (*unguis*); the lamellæ are very strong and tooth-like (Fig. 134). These birds are exceedingly active and predaceous, feeding upon fishes and other aquatic animals, in pursuit of which they not only dip under water in the ordinary manner of the Anatidæ, but even dive with great facility. They generally frequent lakes and rivers, but are occasionally seen on the sea shore; they are inhabitants of the cold northern latitudes, and the majority of the

British specimens are only winter visitors, although some appear to remain with us all the year, and several localities are recorded in which these birds breed regularly every summer. The nest is composed of grass, roots, and other vegetable materials, lined with down, which the female is said to pluck from her own breast; it is placed near

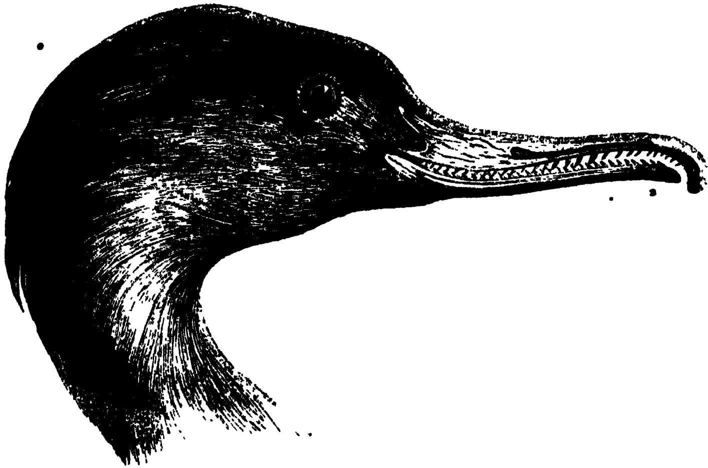


Fig. 134.—Head of Goosander (*Mergus merganser*).

the edge of the water, concealed amongst the bushes or herbage. The eggs vary in number from five to twelve in the different species, and the young take to the water soon after they are hatched. Four species of this group have been recorded as British, but one of these, the Hooded Merganser (*Mergus cucullatus*), is a North American species, specimens of which have occasionally strayed to this country.

In the *Fuligulinæ*, or Pochards, the bill is as broad as high at the base, or nearly so, gradually depressed towards the apex, where the upper mandible is terminated by a curved nail, and the lamellæ are transverse and thin. The legs are short, and the hind-toe is furnished with a broad, membranous, inferior lobe (Fig. 135). The Fuligulinæ closely resemble the Common Ducks in their form, but are generally marine in their habits, and feed voraciously upon Mollusca and Crustacea, which they procure by diving. They also eat aquatic plants. They are clothed with very thick dense plumage, and many of them are adorned with elegant colours, especially the males, the females being usually of a more sober hue than their partners. One of the most remarkable species is the Long-tailed Duck (*Fuligula glacialis*), of which the male has the two middle tail-feathers very narrow, and much elongated. Most of the species breed in the cold regions of the north, and only visit our



Fig. 135.—Hinder Toe of a Fuliguline Bird.

shores during the winter, but a few remain in this country all the year. Like the Mergansers, they make their nests close to the water, and line them with down pulled from their own bodies. The eggs are rather numerous, and the young soon take to the water.

Of the true Pochards (*Aythya*) one of the most celebrated is the Canvas-backed Duck of North America (*A. vallisneria*), which visits the United States from the northern parts of the continent in great abundance about the middle of October. After recruiting themselves for about a month in the United States they become fat, and are then regarded as a great delicacy. Two nearly-allied species are found in Britain during the winter, sometimes on fresh-water pools and rivers and sometimes in the neighbourhood of bays and estuaries.

Another species, which is perhaps still better known to the majority of our readers, is the Eider Duck (*Somateria mollissima*, Fig. 136) an inhabitant of the arctic portions of both Europe and America, where it occurs in the greatest abundance. The down of this bird is regarded as preferable to that of any other for making quilts and similar articles, in which warmth and lightness are required; and the inhabitants of the countries in which the Eider Duck breeds collect the down in large quantities by plundering the nests, which the females line with this material. The female continues laying and plucking fresh supplies of down from her body for some time, and in this manner it is said that about half a pound of down may be procured from each female. This is worth about four dollars a pound. The Eider Duck and a nearly allied species, the King Duck (*Somateria spectabilis*), occur not unfrequently upon the British coasts, and occasionally breed on the Orkneys and Hebrides; but not in sufficient numbers to render it worth while to collect their down. Their flesh is very good.

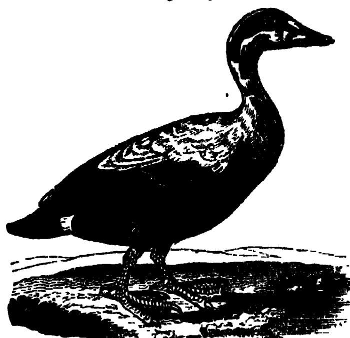


Fig. 136.—Eider Duck (*Somateria mollissima*).

The *Anatinæ*, or true Ducks, closely resemble the preceding groups in their general conformation, and in the form of the bill; but the hinder toe is only furnished with a very small membranous lobe (Fig. 137). The tibiæ, as in the Fuligulinæ, are naked at the extremity. These birds all frequent fresh water, where they feed upon the Worms, Mollusca, and Larvæ which they pick out of the mud. A considerable portion of their food, however, consists of vegetable matters, such as grass, roots, seeds, &c. They are gregarious in their habits, and generally migrate in large flocks. The males are larger than the females, and often adorned with beautiful colours, whilst the females are usually of a more uniform and sober tint.



Fig. 137.—Hinder toe of a true Duck.

They moult twice in the year, in June and November; in June, the males acquire the female plumage to a certain extent, but they regain their proper dress at the second moult, and retain it during the breeding season. The nest is usually placed on the ground, amongst reeds and sedges

near the water, sometimes in holes or in hollow trees, but rarely amongst the branches. The eggs vary from about eight to fourteen in number, and the young are active from the moment of their exclusion, and soon take to the water, where they are as much at home as the old birds.

A well-known example of this group is the common Mallard or Wild Duck (*Anas Boschas*), the original of all the ordinary domestic varieties. The Wild Duck is an inhabitant of all the countries of Europe, especially towards the north; in other parts of this continent it appears to be more or less a bird of passage. It is also abundant in North America. It is plentiful in Britain at all seasons, merely quitting the more exposed situations at the approach of winter and taking shelter in the valleys; or, in case of a severe winter, visiting the estuaries. In a wild state, the Mallard always pairs, and during the period of incubation, the male, although he takes no part in the process, always keeps in the neighbourhood of the female; and it is singular that half-bred birds between the wild and tame varieties always exhibit the same habit, although the ordinary domestic Drakes are polygamous, always endeavouring to get as many wives as they can.

Formerly, before agriculture and drainage had made such great progress in this country, Wild Ducks were far more abundant and generally distributed than they are at present; but they still occur in vast numbers in the fenny districts. They are, of course, an object of pursuit with sportsmen; but the greater part of those taken for sale are captured by means of a peculiar arrangement of nets, commonly denominated a *decoy*. This decoy consists of a large piece of water, situated in the midst of a quiet plantation, from which six semicircular canals are cut, and these are roofed over with hoops and covered in with netting. The Wild Ducks are decoyed into these canals by means of decoy Ducks, which are young Ducks trained to come to a whistle, and the person engaged in working the decoy proceeds along the side of one of the canals and calls the decoys, which are quickly followed by any Wild Ducks that may be upon the water.

A series of reed screens along the sides of the tunnel serve to conceal the decoyman, who proceeds along the convex side, from the birds in its interior, and the man always calls the decoys to that tunnel in which the convex side lies to leeward, so that the birds in advancing may have no chance of perceiving his presence by the sense of smell. In this manner, with the assistance of a well-trained dog, the Ducks are driven up to the further end of the tunnel, which gradually becomes narrower as they advance, and terminates in what is called a tunnel net, which can be detached from the main tunnel as soon as the Ducks have been driven into it. By this arrangement of nets, many other water-fowl are taken besides the common Wild Ducks. The principal captures are late in the autumn and during the winter, after the arrival of the great flights of the northern migratory species, of which the principal are the Teal (*Querquedula Crecca*), the Widgeon (*Mareca Penelope*), and the common Pochard (*Aythya ferina*). All these birds, with the exception of the last-named, belong to the sub-family Anatinæ. Several other species of Ducks visit this country during the autumn and winter, and a few pairs of most of them appear to remain and breed here. Their ordinary breeding stations, however, are generally situated far to the north.

In the Swans (*Cygninæ*) the bill is nearly of the same form as in the Ducks, as are also the feet; which, however, are much stouter in proportion. The bill is rather long, and of nearly equal breadth throughout; and the neck is greatly elongated. These large and elegant birds, of which several species are found in this country, are amongst

the most graceful of the aquatic birds—and few objects in nature perhaps are more pleasing than a large swan moving in its usual majestic manner over the smooth surface of the water. Their wings are very long and powerful, and many of them perform long migrations, during which they always fly in single lines. Their diet is principally of a vegetable nature, consisting of grass, roots, and seeds; but they are said also to feed upon worms and aquatic insects. Swans are gregarious at all seasons. The nest, which is very bulky, is composed of grass, rushes, and coarse herbage, and placed on the ground, generally amongst the sedges of the brink; and several observers have stated that the Swan, when sitting, has been known to add considerably to the materials of her nest, so as to raise it sometimes as much as two feet or two feet and a half, in anticipation of heavy rains, which swelled the waters to such an extent that the nest, if left in its original condition, would have been completely submerged. The male remains in company with the female during the period of incubation, and assists in the care of the young after their exclusion. An interesting instance of the courage and determination of the male Swan in defending his young, is related by Mr. Yarrell. A pair of the Whooping or Hooping Swans (*Cygnus ferus*) had bred in the gardens of the Zoological Society in the summer of 1839. "The Cygnets," says Mr. Yarrell, "when only a few days old, were sunning themselves on the margin of one of the islands, close to the deep water. The parent birds were swimming near. A Carrion Crow made a descent and struck at one of the Cygnets; the old male Hooper came to the rescue in an instant, seized the Crow with his beak, pulled him into the water, and, in spite of all his buffetings and resistance, held him there till he was dead." The name of the Hooper or Whooping Swan given to this bird, which is the common Wild Swan of Europe, is an allusion to the peculiar note emitted by the male, which is said by Mr. Yarrell to be exactly similar to the word "hoop," repeated several times in succession. The intensity of this sound is greatly increased by the convolution of the trachea, which penetrates the keel of the sternum almost to its posterior extremity, and is then bent back upon itself so as to return to the front of the sternum before reaching the lungs.

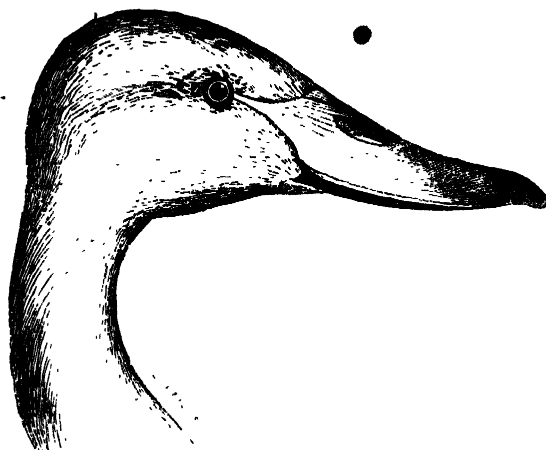


Fig. 138.—The Head of the Whooping Swan (*Cygnus ferus*).

An arrangement in some degree similar to this occurs also in another British species, Bewick's Swan (*Cygnus Bewickii*), which also produces a considerable noise, especially when flying on its migrations; but the trachea of the common Tame Swan (*C. olor*) is quite simple, and the bird has only a soft, plaintive voice, very different from the

strong note of the Hooper. The latter species and Bewick's Swan are winter visitors in this country, nearly all of them quitting our shores in the spring to seek their breeding stations in the most northern countries of Europe. Another species, the *C. immutabilis*, so called from the cygnets being white instead of gray or brownish, as is the case with the other Swans, occasionally makes its appearance in this country during severe winters; it is sometimes brought by dealers from the Baltic, under the name of the Polish Swan, but its summer residence is not accurately known.

The Mute, or Tame Swan (*Cygnus olor*), which is the largest and most elegant of the British species, is also the only one which is permanently resident in our islands. No bird, in fact, presents a more ornamental appearance upon a river or lake than the common Swan; and in this country, at any rate, this bird has been from a very early period the object of various preservative laws. By a law of Henry VII., stealing a Swan's egg was punishable by a year's imprisonment, and a fine at the pleasure of the king. Stealing the Swans themselves, or attempting to do so, was punished still more severely. By an earlier law, no English subject could have property in Swans at large in a public river or creek, except by a royal grant, which is accompanied by a swan mark. Representations of many of these distinctive marks, with other curious particulars relating to what may be called the legal history of the Swan, may be found in the third volume of Mr. Yarrell's "British Birds."

The general colour of the European species of Swans is white, sometimes with a grayish tinge; but a species has been found abundantly in Australia which is entirely black, with the exception of a few white feathers in the wings, and the bill, which is bright red. These birds were very numerous in Van Diemen's Land; and Swan River, on the west coast of Australia, received its name from the great quantities of them which inhabited it at the time of its discovery. The Black Swan (*C. atratus*) is nearly as large as the common white species, and may now often be seen in company with it on ornamental waters.

The *Anserinæ*, or Geese, have a large heavy body, with a tolerably long neck, a small head, and a conical bill (Fig. 139). Their feet are rather long, and the hind toes

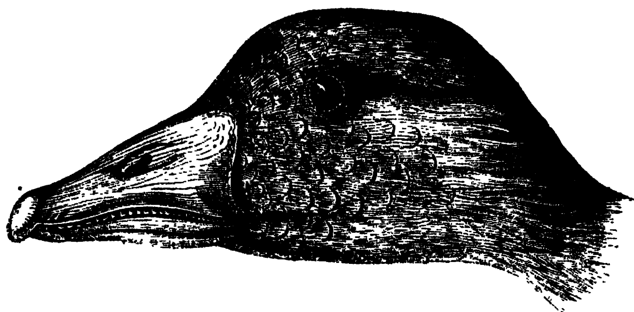


Fig. 139.—Head of the Gray Goose (*Anser ferus*).

very small; the wings are long and powerful. These birds, many of which are only inferior in size to the Swans, resemble these in most of their habits; they live together

in flocks, inhabit the polar regions during the summer, and migrate in autumn in search of a more genial climate in which to pass the winter. During their migrations they fly in long lines, at a great height in the air, continually emitting loud cries. They feed on vegetables, such as grass, herbaceous plants, and seeds, and generally take up their abode in marshy places. In these situations they build their nests, which are of large size, and composed of coarse grass and other herbage. They lay several eggs; and, according to Professor Nilsson, the males quit their partners during the period of incubation, and collect in flocks close to the sea.

Of the True Wild Geese (*Anser*) several species are found in this country, principally as winter visitors, although some species occasionally remain, and breed here during the summer. The Gray Lag Goose (*Anser ferus*, Fig. 139), which is said to have been very abundant formerly in the fenny districts, is now rarely found in Britain; but Mr. Yarrell appears to consider this as the original of our domestic breed, perhaps with a cross of the White-fronted Goose (*Anser albifrons*), which still visits our shores in considerable numbers during the winter. The commonest of the British species is the Bean Goose (*Anser segetum*). The Bernicle Geese (*Bernicla*) are marine in their habits, and feed almost entirely upon Algæ and upon the Grass-wrack (*Zostera marina*). Like the Common Geese, they are only winter visitors in our climates, and pass during the summer to the highest northern latitudes. The name of Bernicle or Barnacle Geese, applied to these birds, alludes to an absurd fiction which was related as sober truth by the older naturalists, that these birds were produced from the common Barnacles, the latter in their turn originating, according to some accounts, from the fruits of a particular tree whose branches dipped into the water. This ridiculous notion is not yet entirely exploded in the minds of the ignorant.

A curious form belonging to this sub-family is the *Cereopsis* of New Holland (*Cereopsis Novæ-Hollandiæ*), which presents a considerable resemblance to the Common Geese, but has the front of the head covered with a yellowish leathery skin, and the legs much longer in proportion than in any other Goose, with the extremities of the tibiæ covered with a naked skin. This bird has a good deal of the grallatorial character about it, and is considered by some writers as forming one of the links uniting this order with the following one.

But a far closer approach to the Grallatorial Birds is made by the Flamingoes (*Phœnicopterinæ*), which were, in fact, placed amongst the Waders by most of the older naturalists, down to the time of Cuvier and even later. The whole organization of these birds, however, shows that they must be referred to the Natatores, and indeed to the family Anatidæ, with which they agree in all essential points, although, at the same time, they undoubtedly present several extraordinary characters.

The *form* of the bill is quite sufficient to distinguish the Flamingoes from any other members of the order Natatores. It is large and thick, the lower mandible has a somewhat oval form, with the sides turned up so as to constitute a sort of semi-cylindrical channel; whilst the upper mandible is broad and rather flat, and bent suddenly in the middle so as to fit exactly to the edges of its fellow. The margins of the two mandibles are furnished with very fine transverse lamellæ, which are described by Cuvier, who says that these, taken in conjunction with the thick fleshy tongue, show that the Flamingoes are closely allied to the Ducks; but some of the other naturalists, who place them, with Cuvier, amongst the Grallatorial birds, appear to have entirely overlooked these characters, whilst others describe them, but make no mention of the relationship thereby indicated.



Fig. 140.—The Flamingo (*Phœnicopterus ruber*).

It is, however, to the great length and slenderness of the legs and neck that the Flamingoes are indebted for their being regarded as wading birds; and it must be confessed that, in these respects, they exceed most of the birds properly belonging to the Grallatorial order. The legs are excessively long and slender, and the greater part of the tibiæ are bare of feathers, as in many of the waders; but the three anterior toes are completely united by a membrane. The elongation of the neck is, of course, intended to enable the birds to reach the surface upon which they are standing; and yet it is scarcely greater than that seen in many short-legged Natatorial Birds.

In their habits and mode of life they also agree essentially with the swimming birds. They live upon the sea-shore, where they feed upon Mollusca, Crustacea, and young fishes, for which they dabble about in the mud and sand, with their broad bills, in exactly the same manner as a duck, and when thus employed the object of the

peculiar conformation of the bill is plainly seen. When the neck is turned downwards to reach the ground in the most natural position, the bent apical portion of the upper mandible is necessarily directed downwards; this, then, takes the place of the lower mandible in the Duck, and serves to scoop and feel about in the mud. The tongue also assists wonderfully in the process of straining the muddy water, and retaining the food; it is furnished with numerous spines on its surface, and these are pressed by the mere weight of the tongue against the lamellæ of the upper mandible when the animal is feeding with its head in this reversed position.

They are exceedingly gregarious in their habits, collecting into large troops in the marshes, where they follow the rise and fall of the tide in their search for food, so that they are often seen extending in single file over a considerable space. When standing in this way, the common Flamingoes (*Phœnicopterus ruber*, Fig. 140), which stand about five feet in height, and are of a fine rose colour with bright red wings, are said to produce exactly the effect of a regiment of soldiers standing in line. Whilst the community is thus engaged in seeking the means of subsistance, certain of its members are said to be employed in the capacity of sentinels, to give notice of the approach of danger; this is done by a loud cry, like the sound of a trumpet, on hearing which the whole will take wing and escape to some place of greater security. They also migrate in large flocks, when they fly in an angular line, like that frequently formed by Geese and Swans in their migrations.

The females are smaller and less brilliantly coloured than the males. They form a most singular nest of mud in the shape of a hillock, with a cavity at the top; in this they lay two or thee white eggs, and then sit astride upon the top with one leg on each side. The young are able to run within a few days after their exclusion from the egg.

The common Flamingo (Fig. 140) is found in the South of Europe, especially in Sicily, Calabria and Sardinia, but it is more abundant in the warm regions of Africa and Asia. They are exceedingly beautiful birds, their plumage being of the most delicate character, and their flesh is said to be equally good. Flamingoes were amongst the objects of the extravagance of the Roman epicures, and a dish of the tongues of these birds was regarded as a great delicacy. A species of about the same size as the European bird is found in most parts of America, migrating from the tropical regions as far north as the southern states of the Union. It is the *Phœnicopterus chilensis* of Molina.

## Order II.—Grallatores.

**General Characters.**—In the Grallatorial or Wading Birds the feet are always formed for walking, usually of great length, and the toes are never united by a membrane, in the same way as in the preceding order. They are, however, sometimes surrounded by membranous lobes, and in many cases furnished with a small web at the base. The great length of the legs is generally due to the elongation of the tarsi; but the tibiæ are also frequently very long, and generally bare of feathers for a greater or less extent. The naked portion of the tibiæ is covered with a reticulated skin, like that of the tarsi and toes; but in many cases the latter are more or less covered with horny plates or scutella. The toes are usually four in number—three in front and one behind; the latter varies greatly in its development, being sometimes very small, and sometimes as long as, or longer than the others; it is placed either on the same level with the anterior toes, or raised more or less upon the back of the tarsus. The anterior toes are

usually elongated, and the two outer are often united together for a certain portion of their length.

The great length of the legs in the majority of these birds enables them to wade with great facility* in shallow water in search of the fish and other aquatic animals upon which they feed; hence the name of Grallatores or Waders applied to the order. In many cases, however, this does not apply; for the legs of several species are too short to be of any use to them in wading; whilst other species, in which the legs are much elongated, are inhabitants of dry situations, and are never found in the vicinity of water. Some species run upon the surface of aquatic plants, and others swim and dive with greater facility than many of the true Natatorial birds. They are all active birds, running with great swiftness, and usually possessing great power of flight.

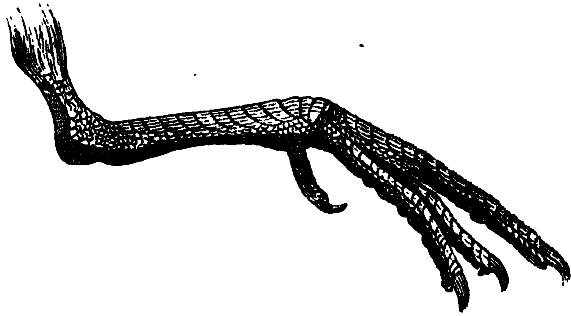


Fig. 141.—Foot of Gallinule (*Gallinula chloropus*).

The development of the neck keeps pace with that of the legs, and in most cases the beak also is of considerable length. The latter organ is almost always longer than the head, usually of an elongated conical form, sometimes almost cylindrical, and occasionally flattened and more or less dilated. The tongue is fleshy and usually triangular.

The wings are well developed, often of great size, and the birds are almost always powerful fliers, although many of them, when disturbed, appear to prefer trusting to their long legs to betaking themselves to the air. The plumage is soft, and bears a certain resemblance to that of the Natatorial birds, but the feathers are generally furnished with a distinct plumule.

The habits of these birds vary considerably Most of them inhabit the vicinity of water or marshy places, where they wade about in search of aquatic animals, or walk upon the moist ground and amongst the rank herbage, seeking for worms and insects. A few are found in dry situations, but their food is of much the same nature as that of their marsh-loving brethren, and very few appear to take any considerable portion of vegetable nourishment.

**Divisions.**—The birds of this order may all be referred to six family types. In the first of these, the *Rallidæ*, or Rails, the bill is always short, rarely longer than the head, strongly compressed and wedge-shaped; the upper mandible usually has a groove on each side, near the middle of which the nostrils are situated The latter are pervious—that is to say, they open through the bill. The ridge of the bill is often more or less expanded at the base, and sometimes forms a large plate, covering the forehead (Fig. 142). The legs are stout, not very long, sometimes short; but the toes are usually of great length, and frequently armed with very long claws. The wings are of moderate size, and in some genera armed with spines at the carpal joint. The

neck is rather short, and the head small, oblong, and compressed. The body, also, is much compressed in form, and the tail is very short.

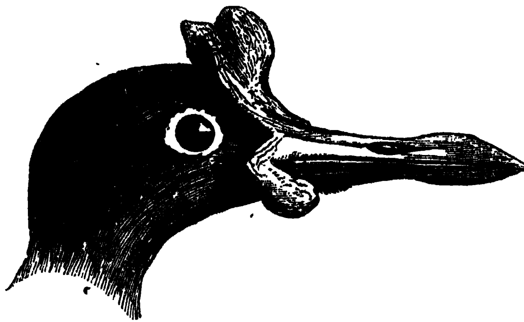


Fig. 142.—Head of Jacana (*Parra Jacana*)

The throat and œsophagus are of moderate width, and there is no crop; the stomach forms a strong gizzard, and the intestine is long, and furnished with rather large cœca.

The relations of these birds are somewhat singular. In their general form, and indeed in some points of their internal anatomy, they resemble the Gallinaceous birds, and their food also partakes of the same nature; whilst, on the other hand, some of them are furnished with membranous lobes on the toes. Many can swim with ease, and a few actually exceed many of the true Natatorial birds in the facility with which they not only move upon the surface of the water, but even dive into its depths. They generally live amongst the sedges, rushes, and other plants at the edges of water, and some also in corn-fields; but, in either situation, the compressed form of their bodies is peculiarly adapted to allow them to pass with ease amongst the stems of the plants. Their elongated toes also enable them to support themselves upon floating aquatic plants.

The Rallidæ feed principally upon worms, mollusca, and insects; but many also eat a good deal of vegetable food, such as blades of grass and seeds. Some of them are solitary, others more or less gregarious in their habits. They build a large nest of dried grasses and sedges, placing it upon the ground amongst thick herbage; the eggs vary considerably in number, and the young are able to run, and frequently to swim, as soon as they are hatched.

The British species all belong to that section of the family which constitutes the family Rallidæ of Mr. G. R. Gray. They have the beak but slightly arched towards the tip, the wings unarmed, and the claws of moderate length. In the Gallinules (*Gallinulinæ*), or Water-hens, the base of the ridge of the bill is dilated into a soft, oblong plate, which occupies a greater or less extent of the forehead. These birds are especially aquatic in their habits, living amongst the reeds and sedges of the banks of rivers and lakes, and in marshy places, and swimming and diving with great facility. Their food consists of insects, worms, and mollusca, with a considerable proportion of seeds, especially those of the Graminaceous plants. The British species of Gallinule (*Gallinula*

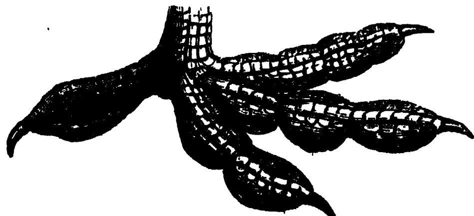


Fig. 143.—Foot of the Coot (*Fulica atra*).

*chloropus*) is about twelve or thirteen inches in length, and of a dark gray colour, olive-brown above; the bill and frontal plate are yellow and red, and the legs green. The name of Gallinule applied to these birds alludes to the close resemblance which they present to small hens when running about upon the ground. The Coots, of which one species (*Fulica atra*) is also found in Britain, are very similar to the true Gallinules in their habits, but are still more strikingly adapted for an aquatic life, the toes being bordered with broad membranous lobes (Fig. 143), which give the feet a considerable similarity to those of the Grebes, (see page 160). From this circumstance M. Temminck arranged the Coots and Grebes together in one order, to which he gave the name of *Pinnatipedes*. These are the only species of the Gallinulinæ that occur in Britain, and they remain in our islands all the year.

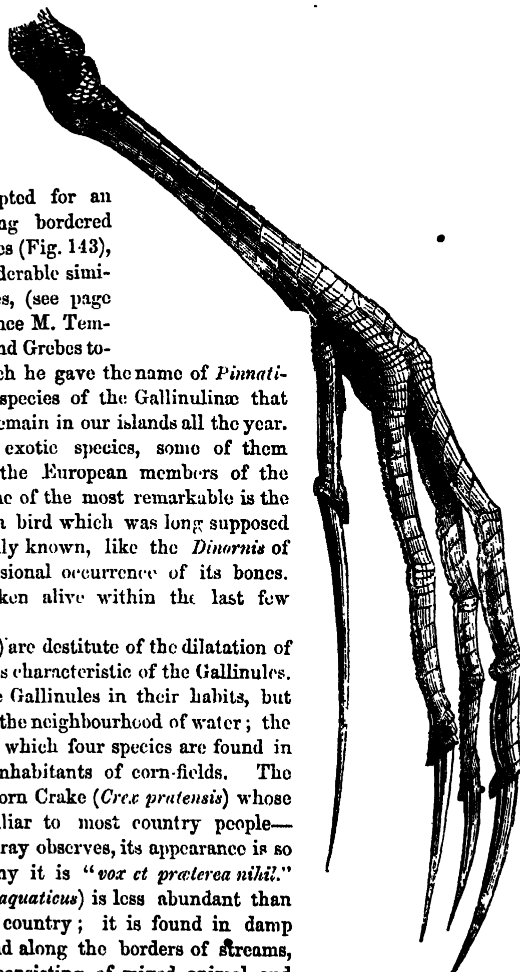


Fig. 144—Foot of the Jacana (*Parra Jacana*).

There are numerous exotic species, some of them considerably larger than the European members of the group. Amongst these, one of the most remarkable is the *Notornis* of New Zealand, a bird which was long supposed to be extinct, as it was only known, like the *Dinornis* of those islands, by the occasional occurrence of its bones. It has, however, been taken alive within the last few years.

The true Rails (*Rallinæ*) are destitute of the dilatation of the base of the bill which is characteristic of the Gallinules. They closely resemble the Gallinules in their habits, but remain less exclusively in the neighbourhood of water; the common Crakes (*Crex*), of which four species are found in Britain, being generally inhabitants of corn-fields. The commonest species is the Corn Crake (*Crex pratensis*) whose cry of *crek, crek*, is familiar to most country people—although, as Mr. Macgillivray observes, its appearance is so little known that to many it is "*vox et præterea nihil.*" The common Rail (*Rallus aquaticus*) is less abundant than the Corn Crake in this country; it is found in damp meadows and marshes, and along the borders of streams, where it seeks its food, consisting of mixed animal and vegetable matters. The Rail remains in this country all the year round; but the Crakes generally migrate, arriving in April and May, remaining during the summer for the purpose of breeding, and leaving us again about September. They all form a large nest of grass and other herbage, and the young are able to run about the moment they leave the egg.

In a second section of the family—the *Palamedeidæ* of Mr. G. R. Gray—the bill is considerably arched towards the tip (Fig. 142), the wings are armed with spurs, and the claws are very long and acute (Fig. 144). These birds are all exotic, and resemble the Rails in their general habits, but feed much more generally upon vegetable substances; the great length of the toes, in most species, enables them to run with great ease upon the floating leaves of aquatic plants. In the common Jacana (*Parra Jacana*), which inhabits Brazil, the claw of the hind toe is excessively elongated and acute, from which circumstance the name of the *surgeon* has been applied to it. The base of the bill is furnished with a large free dilated plate (Fig. 142), which stands up in front of the forehead.

In the genus *Palamedea* the forehead is furnished with a singular hornlike process, and the wing bears two spurs. The best known species, *P. cornuta*, inhabits the marshy districts of Brazil and Guiana. This bird is larger than a goose, and of a blackish colour, with a red patch on the shoulder. It lives in pairs, and has a very strong voice, which may be heard at a great distance. The Chaja (*Chauna chavaria*) is another nearly allied species, which has a circle of moveable feathers on the occiput. This is also an inhabitant of Brazil, where it is frequently brought up in a domesticated condition amongst the fowls and geese, which, as it is exceedingly courageous, it is said to protect from the attacks of birds of prey. A remarkable peculiarity exhibited by this bird is that the skin is separated from the flesh by a considerable interval, occupied by a loose cellular structure which is filled with air, so that the skin crackles under the finger. The same arrangement of the skin occurs in some Cormorants and Gannets.

The second family is that of the *Scolopacidæ*, or Snipes, in which the bill is long, slender, and somewhat cylindrical (Fig. 145); generally obtuse, flexible, and covered

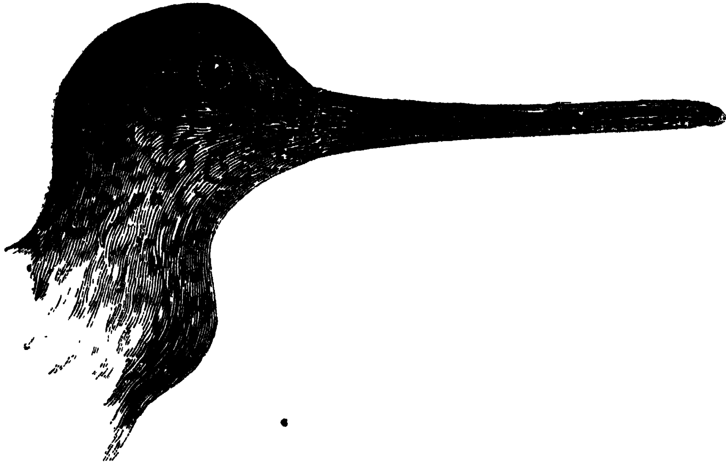


Fig. 145.—Head of the common Snipe (*Scolopax gallinago*).

with a soft skin, which towards the extremity is often abundantly supplied with nerves. The upper mandible is longer than the lower, and usually grooved on each side; in the basal portion of the grooves the small nostrils are situated. The tongue is elongated and slender; the œsophagus narrow, and the stomach very muscular.

The legs are short, and the tibiæ are generally feathered lower down than in the generality of Grallatorial birds, the feathers sometimes extending to the bend of the foot. The toes, especially the hinder one, are much shorter than in the preceding family, and frequently more or less connected by membrane; in some cases they are surrounded by membranous lobes.

These birds are always of small size. They inhabit marshy places and the margins of rivers and brooks, where they walk about in search of their food, consisting of worms and insects, which they extract from the mud or soft ground by means of their long bills. They are exceedingly numerous, and present many differences in form and structure, which have given rise to the formation of several sub-families.

The Phalaropes (*Phalaropinæ*) resemble the Coots in having the toes bordered with membranous lobes (Fig. 146), and, like these, were included by Temminck in his order of *Pinnatipedes*. As might be expected from this conformation of the feet, the Phalaropes are very aquatic in their habits, swimming with great ease, and being often met with amongst floating sea-weed at a great distance from land. Their movements, when swimming, are very elegant, resembling those of the Teal; and they are continually dipping their bills into the water in search of the small insects and Crustacea upon which they feed. Two species are found in this country, but only as winter visitors, their summer residence and breeding station being on the shores of the Arctic regions.



Fig. 146.—Foot of Lobipes hyperboreus.

The *Scolopacinæ*, or true Snipes, have a very long, straight, flexible bill, which is much compressed through the greater part of its length, but is slightly enlarged at the extremity, where its soft skin is furnished with numerous nerves; the tarsi are short, the hinder toe very small and elevated, the anterior long and slender.

These birds are found in sequestered marshy situations, where they may be seen poking their delicate and sensitive bills into the mud in search of the worms and larvæ which constitute their food. Several species are found in this country, but only as winter visitors, their breeding-grounds being situated far to the north, although a few appear to remain with us during the summer. They usually make their nests in slight hollows, lined with fragments of grass and sedge, and lay four eggs. Although these birds are of small size, their flesh is regarded as a great delicacy, and they generally attract a good deal of the sportsman's attention. The largest British species is the Woodcock (*Scolopax rusticola*), which measures about fourteen inches in length.

Of the foreign species, those of the genus *Rhynchæa* are remarkable for the brilliancy of their colours and for the ocellated spots upon the quills of their wings and tails. There are several species, found at the Cape of Good Hope, in India, Madagascar, and Australia.

The *Tringinæ*, including the Sandpipers and numerous allied birds, differ from the Snipes principally in the greater length of their legs. The bill is long, slender, grooved throughout, sometimes straight, sometimes curved either upwards or downwards. The hinder toe is very small and elevated on the back of the tarsus, or sometimes entirely wanting, and the anterior toes are usually slightly webbed at the base. Many of the Sandpipers present a good deal of resemblance to the Snipes in their appearance; and, like these, they are generally found in the neighbourhood of water—some of them even swimming with facility. They collect in flocks during the winter, seeking for their

food, which consists principally of worms, insects, and mollusca, by inserting their long bills into the mud or soft ground of the shore. In the winter they not unfrequently visit the sea-coast. They run and fly rapidly, and most of them produce a shrill and loud cry. They are migratory birds, visiting this country in the autumn and winter, and retiring to the high northern latitudes to breed during the summer; some appear only to pay us a passing visit in their vernal and autumnal journeys between their summer and winter residences. Nevertheless, great numbers of many species reside permanently and breed in our islands; in fact, some individuals of almost all the species pass the summer here.

The Curlew (*Numenius arquata*), distinguished by its curious curved bill (Fig. 147), does not appear to migrate at all, except from the sea-coast, where it passes the winter season, to high grounds, such as moors, &c., where it forms its nest and rears its

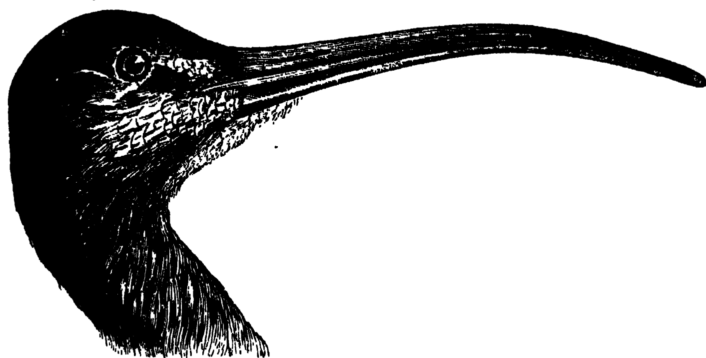


Fig. 147.—Head of the Curlew (*Numenius arquata*).

young. The Curlews, like the other birds of this sub-family, lay their eggs in small hollows lined with fragments of heath, grasses, and other vegetable matters. These birds also exhibit a considerable degree of ingenuity in leading intruders away from their nests and young. They will feign themselves severely wounded and scarcely able to run, or broken-winged and exhausting their strength in vain efforts to rise from the ground, thus inducing the pursuer to hope that the prize cannot escape him; but when the wily bird has led him to a sufficient distance from the objects of her anxious affection, she will rise into the air with apparent exultation, and fly back to the spot whence she came.

Perhaps the most remarkable bird belonging to the present group is the Ruff (*Philomachus pugnax*), a small bird of about ten or twelve inches in length, which was formerly very abundant in this country, but now occurs in comparatively small numbers. The most striking peculiarities of this bird, which is the only species of its genus, are expressed in its names—the English name being applied to it in allusion to a large ruff of feathers which is attached to the head and neck of the male during the breeding season; whilst its more learned appellations refer to the great pugnacity displayed by the males at that period. This pugnacity is very opposite to the general disposition of the Grallatorial birds, as is also the practice of polygamy in which the Ruff indulges, and which is indeed the cause of the continual fighting that goes on during the breeding season. "Their actions in fighting," according to Montagu, "are

very similar to those of a game cock; the head is lowered and the beak held in a horizontal direction; the ruff, and indeed every feather, more or less distended, the former sweeping the ground as a shield to defend the more tender parts; the auricles erected, and the tail partly spread,—upon the whole assuming a most ferocious aspect. When either could obtain a firm hold with the bill, a leap succeeded, accompanied by a stroke of the wing; but they rarely injured each other." These birds (with the females, called *Reeves*) are taken alive in the fenny districts of England, and fattened upon bread and milk or boiled wheat before being sent to market, where they fetch from thirty shillings to two guineas, or more, per dozen. They are also imported into London from Holland; and Mr. Thompson, of Belfast, mentions a case in which out of two or three hundred of these birds which were put on board a steamer at Rotterdam in a large basket, only about one-half arrived alive in the Thames, the remainder having fallen in the incessant battle which was going on throughout the voyage. In the Lincolnshire fens the Ruffs are taken by means of nets, into which they are decoyed by stuffed skins, which the fowler places there, and which are often so arranged that they can be made to leap up by pulling a string. At the time Montagu wrote, however (1813), the number of these birds was so small as hardly to remunerate the fowlers for the trouble and expense of their capture. Another species, which is occasionally taken and fattened with the Ruffs, is the Godwit (*Limosa melanura*), which is a much larger bird than the Ruff, being from sixteen to seventeen inches in length. It is not, however, so highly esteemed for the table.

The last sub-family is that of the *Totaninæ*, to which Mr. Macgillivray gives the English name of Tatlers. In these birds the bill is very long, slender, compressed and acute; the legs are also very long and slender, and the toes of moderate length, webbed at the base, the fourth very small or entirely wanting.

The Totaninæ are genuine wading-birds, which always frequent the water's edge, and generally seek their food in the water, although they occasionally imitate the birds of the preceding sub-families in their practice of pushing the bill into the sand or mud of the brink. Some of them also take to the water and swim without hesitation, although the structure of their feet does not appear very well adapted for such a purpose. They are found not only upon the banks of rivers and lakes, and in the marshy grounds in their vicinity, but also frequently upon the sea-shore; and in the winter they generally collect into small bands and frequent the neighbourhood of the sea, and especially the estuaries of rivers. Their food consists of Insects, Mollusca, Crustacea, Worms, and other aquatic animals. They run and fly swiftly, and emit loud and shrill cries. Most of the species perform migrations of greater or less extent; the British species being generally winter visitors, and breeding in regions far to the north, although some of them generally remain during the summer, and one or two appear to be permanent residents.

Of the British species the Stilt (*Himantopus melanopterus*, Fig. 148) is remarkable for the great length of its legs. The habits of this bird are but little known, but Mr. Gould, in describing a species found in Australia, says that although the extreme length of the legs, as compared with the small size of the body, would seem incompatible with easy carriage and graceful deportment, this in reality is not the case, for he never saw a bird which combined more grace of movement and elegance of appearance. They associated in small flocks of from six to twenty in number, and their picturesque appearance as they ran along the margin, and waded knee-deep in the shallows of the stream, added greatly to the beauty of the scene. They were feeding

on insects and small snails. The habits of an American species, *Himantopus nigricollis*, are described by Wilson, and appear to be very similar, except that the birds frequent the pools of the salt marshes rather than rivers. During the breeding season they form small associations, consisting of six or eight pairs, which build their nests within a few yards of each other. The nests consist at first of a small quantity of grass, just sufficient to keep the eggs from the wet ground; but as they continue sitting they add to the materials of the nest, so as to raise it by degrees, probably in dread of a sudden rise in the water.

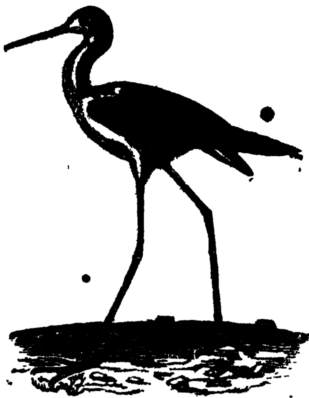


Fig. 148.—Stilt (*Himantopus melanopterus*).

The Avocet (*Recurvirostra avocetta*, Fig. 149), which is also a British species, has the bill gently curved upwards, giving it a very singular appearance. The Avocet is a good-sized bird, measuring about eighteen inches in length, and its plumage is handsomely variegated with black and white. The feet are much more deeply webbed than in the generality of these birds; but this palmation appears only to be intended to give the bird additional support when walking upon the mud, as Mr. Yarrell states that it never attempts to paddle or swim when out of its depth, but allows itself to float along motionless. Wilson, however, states that the American species (*R. Americana*), like the American Stilt, occasionally swims for a few feet when it happens to get beyond its depth in wading. The Avocet is now a rare bird in England, but was formerly tolerably abundant in the fenny districts. In searching for food, the object of the peculiar form of the bill becomes apparent; it moves its head from side to side, passing the bill through the soft mud with a scooping motion, whence the name of *Scooper* sometimes applied to it. Mr. Audubon states, that the American species pursues insects on the surface of the water, and, on reaching them, suddenly seizes them by thrusting the lower mandible below them. In this scooping action of the bill the Avocets resemble the Spoonbills belonging to the following family.

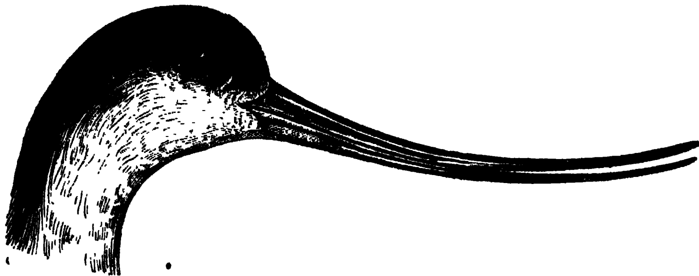


Fig. 149.—Head of the Avocet (*Recurvirostra avocetta*).

In this family, that of the *Ardeidæ*, or Herons, we find the most typical species of

the order—stately birds, which stalk majestically along, and often stand sedately watching for their prey. The legs are long and slender, with a large portion of the tibiæ naked; the tarsi are usually scutellated, and the hind toe is of large size, and placed on the same level as the anterior toes. The bill is large, strong, and usually conical; the œsophagus is wide, and the stomach large, furnished with a thin muscular coat and a soft epithelium, indicating a very different description of food from that which forms the diet of the birds to which we have previously referred. The wings are very large and powerful, but the flight of the birds is generally slow. They frequent the margins of water, feeding upon aquatic animals of all kinds; but fish and frogs constitute a considerable portion of the nourishment of the larger species. They are generally migratory in their habits, and often perform very long journeys.

Of the sub-families into which this great family is divided, the Spoonbills (*Plataleinæ*) are distinguished by the very singular form of their bills, which are flattened, gradually narrowed from the base to a little beyond the middle, and expanded at the extremity into a flat oval disc. The toes are connected by membranes at the base. The common White Spoonbill (*Platalea leucorodia*, Fig. 150), which is about thirty or thirty-two inches in length, is generally distributed over the continent of Europe, but is a rare bird in England. It is also found in Africa, according to Mr. Yarrell, as far south as the Cape of Good Hope; and Colonel Sykes brought specimens from India, which, although larger than the European bird, agreed with it exactly in all other particulars. It is migratory in its habits, retreating to the South of Europe and North Africa during the winter, and advancing far to the north during the summer to breed. One of its favourite summer residences, however, is Holland, where it occurs in great numbers. Its food consists of small fishes, Mollusca, Worms, and Insects. A beautiful species, the Roseate Spoonbill (*Platalea Ajaja*) is found in all parts of South America; its plumage is of a beautiful rose colour, with the wings of a rich carmine.


Fig. 150.—Spoonbill (*Platalea leucorodia*).

From the Spoonbills we pass readily to the Ibises (*Tantalinæ*), in which the bill is gently curved downwards (Fig. 151) like that of the Curlew. In their general structure and habits they closely resemble the Spoonbills, frequenting the margins of water and feeding principally upon Worms and Mollusca. The only species found in Britain is the Glossy Ibis (*Ibis falcinellus*) which is about two feet long, of a fine reddish-brown beneath and dark green above, with the whole of the plumage beautifully silky and glossed with purplish-bronze. This bird occurs commonly in the south of Europe, and also in India, Egypt, Siberia, and many of the intervening regions. It is supposed to be the Black Ibis of the ancients. This, and a White species (*Ibis religiosa*, Fig. 152),

which also occurs abundantly in Egypt, were regarded with great veneration by the ancient Egyptians, who kept them in their temples, and embalmed them after their death. Various reasons have been given for this custom, some saying that the Ibis

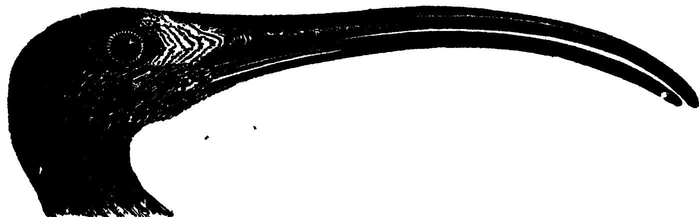


Fig. 151.—Head o the Glossy Ibis (*Ibis falcinellus*).

destroyed the noxious Serpents which were so numerous in that country; others that there was supposed to be some analogy between the plumage of the bird and one of the phases of the moon; whilst a third opinion is that the birds were regarded with favour because, their annual migration into Egypt taking place at the period of the rising of the Nile, they were considered as the harbingers of that phenomenon.

The plumage of the Sacred Ibis (Fig. 152) is of a pure white colour, with the exception of the tips of the wings, which are black. The head and neck are naked and black, and the bill and feet are of the same colour. One of the most beautiful species is the Scarlet Ibis (*Ibis rubra*), which is found in almost all the warmer parts of America. It is entirely of a fine scarlet colour, with the exception of the extremities of the four outer quill-feathers in the wings, which are of a deep steel blue. On the Amazon this bird, with the Roseate Spoonbill, is said to present a most charming appearance. Most of the birds of this group perform migrations of greater or less extent.

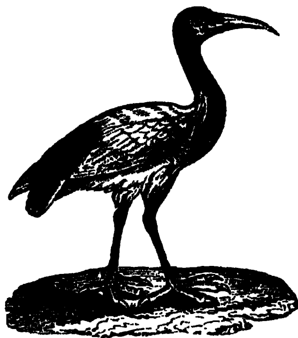


Fig. 152.—Sacred Ibis (*Ibis religiosa*).

The Storks (*Ciconinæ*) have the bill stout, conical, compressed, and pointed, with the nostrils placed near the base, without a groove; the gape does not extend under the eyes. The tarsi are reticulated, the toes rather short and stout, and united at the base by a considerable membrane; the claw of the middle toes is not denticulated. In the common Storks, of which two species (*Ciconia alba* and *nigra*) are found in this country, the bill is straight and pointed; but in the Jabirus (*Mycteria*) it is turned up at the tip, and in the Openbills (*Anastomus*) the two mandibles are in contact at the base and apex, but from their being slightly curved in opposite directions, have a considerable space between them in the middle.

The Storks are all large birds, which chiefly inhabit the warmer regions of the earth, where they frequent marshy places, feeding upon Reptiles, Batrachians, Fishes, and other small animals, not excluding small quadrupeds and birds. Many of them devour indiscriminately almost any thing that comes in their way, including garbage of all kinds; hence, like the Vultures and other carrion-eating animals, they are

regarded with great favour by the inhabitants of warm climates. Several species perform long migrations, visiting temperate and cold climates during the summer; but the majority appear to be permanently resident in warm countries.

The British species are, of course, migratory in their habits, and, in fact, must be regarded only as occasional visitors to our shores; but in Holland and Germany they are tolerably abundant. The best known species is the White Stork (*Ciconia alba*), which is about three feet and a half in length, and is of a white colour, with the quills and coverts of the wings black, and the bill and feet red. These birds visit the central parts of Europe in the spring, and remain there during the summer, departing usually in the month of October for their winter quarters in Asia and Africa. Their services in the countries frequented by them, in the destruction of vermin of all kinds, preventing their being the objects of any molestation, they are generally very fearless of man, and frequently build their nests on the tops of the buildings in the very centres of towns; indeed, in many places, the inhabitants place wooden boxes or frames on the tops of their houses to induce the Storks to build there; and the man whose house is selected by a Stork for this purpose, always considers himself particularly fortunate. They return annually to breed in the same place, and are said to manifest great delight on again taking possession of their deserted home.

The nest is formed of a mass of sticks and other coarse materials, in which the bird lays three or four eggs, which are hatched in about a month, and the young are then attended with great care by both parents, who feed them by inserting their bills into the mouth of the young bird, and disgorging some of the half-digested food from their own stomachs. The old birds manifest the greatest attachment to their young, which has rendered them objects of admiration in all ages. A most remarkable instance of this occurred in the conflagration of Delft, where a female Stork was observed, after repeated attempts to carry off her young, to prefer remaining with them to perish, rather than leave them to their fate. They are also generally regarded as patterns of conjugal fidelity; but Professor Schinz relates a singular anecdote, which, if true, shows that this rule is liable to exceptions. He says that a pair of Storks had bred happily for several years in a village of Switzerland, but that on one occasion, soon after their return to their old quarters, it was observed that as soon as the male had left the nest to seek his food, a younger male always advanced to make his court to the female which remained in the nest. At first, the lady received the advances of her young suitor with great disdain; but, as he did not allow himself to be frightened away by this behaviour, but always presented himself as soon as her rightful lord had taken his departure, his advances were gradually received with more and more favour, whilst the unfortunate husband was treated with a proportional degree of unkindness. At length, one day, when the male had gone in search of food to a neighbouring meadow, his faithless spouse flew after him with her new lover, and both attacking him with their sharp bills soon laid him dead on the ground. The pair then returned and took possession of the nest.

Amongst the most remarkable of the Ciconinæ are the Adjutants, or Gigantic Cranes, of which one species, the *Leptoptilus argala*, which inhabits India and the Indian islands, often stands as much as five feet in height, and measures seven feet and a-half from the extremity of the bill to that of the toes. This gigantic bird has a large, slightly bent bill; the head and neck are nearly bare, and in front of the neck is a large pouch, which hangs down like a dewlap, and is capable of being inflated. Its voracity is extreme; it devours everything that comes in its way, and swallows a

rabbit, a cat, or even a leg of mutton, at one mouthful; and as, from its services as a scavenger, its presence is encouraged in the towns, and it is even sometimes domesticated, great care is necessary to keep provisions out of its way, as otherwise they would quickly disappear. In a wild state, they live in companies, generally frequenting the mouths of rivers, where, at a distance, they look not unlike a party of men engaged in picking up shell-fish on the beach. A rather smaller species, the *Leptoptilus marabou* (Fig. 153), is found in the tropical portions of Africa, where it frequents the vicinity of the negro villages, and assists the Vultures in their filthy avocation of clearing away garbage. This bird is still more singular in its ugliness than the Indian species; but it is from it that the beautiful plumes known as Marabout feathers are obtained. These feathers grow under the wings.



Fig. 153.—African Adjutant (*Leptoptilus marabou*).

The Jabirus (*Mycteria*) are but little inferior in size to the Adjutants, which they doubtless resemble in their mode of life. One species, which has the head and neck bare, is found in South America; those of the old world have those parts of the body clothed with feathers. The Open-bills (*Anastomus*) are about the size of the common Stork: they inhabit the warmer regions of Asia and Africa. A species found at the Cape, the *Anastomus lamelliger*, which is of a brown tint, with a purplish metallic gloss, is remarkable for having the tips of the stalks of nearly all the feathers terminated by a shining black horny disc of an oblong form.

The true Herons (*Ardeinæ*), with which we close our account of this family, present a great resemblance to the Storks in their general form, but are distinguished by the

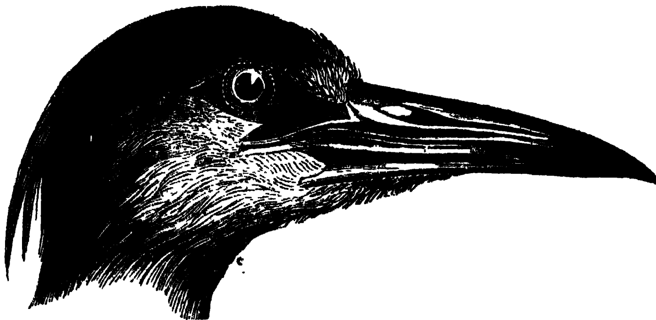


Fig. 154.—Head of the Night Heron (*Nycticorax Gardeni*).

following characters:—The bill is usually of a conical form, and nearly as stout as in the common Storks; but the nostrils are situated in pits on the sides of the upper

mandible, and from this a furrow runs to a greater or less distance forwards, sometimes nearly reaching the extremity of the bill. The gape opens as far as the eyes, which are surrounded by a naked skin. The tarsi are scutellated; the toes rather long and slender, and less united by membrane than those of the Storks; the inner margin of the claw of the middle toe is denticulated.

The Herons in general are smaller than the Storks, and some of them are very small. They are solitary in their habits, frequenting the margins of lakes and rivers, or marshy places, in which there are numerous pools of water, wading into the shallows in search of their prey, which consists principally of fish, and often standing motionless for a long time, watching until some fish passes within their reach, when they suddenly dart out the neck with greet rapidity, seize their prey with their strong bills, and generally swallow it at once. Occasionally, either by design or accident, they transfix the fish with one of the mandibles; and Mr. Yarrell has given an account of a case in which a Heron struck its beak through the head of an eel, piercing both eyes, when the eel, finding itself unable to escape, coiled itself round the neck of the Heron so tightly as to prevent the bird from breathing, and they were both found dead in this situation. They walk gravely, and with a certain amount of elegance, and possess great power of flight, although they rarely fly very fast. At the breeding season they usually quit their customary solitude, and collect into communities of variable number. Their nests are broad and flat, formed of sticks, twigs, and similar materials, and placed sometimes on the ground and sometimes on trees. At this period they also frequently leave the sequestered spots in which they pass the greater part of their time, and approach nearer to the habitations of man, often building their nests in the large trees surrounding some old mansion. Most of these birds are migratory, and the majority of the species recorded as British only visit us in the summer, and several of them must be regarded as mere occasional visitors. Some, however, remain with us all the year round.

The commonest species, at all events in this country, is the Gray or Crested Heron (*Ardea cinerea*, Fig. 155), a large bird upwards of three feet in length, of a bluish-gray tint above, white beneath, and furnished with a black crest attached to the back of the head. This bird is very common in all parts of this country, inhabiting the lakes, rivers, and inland morasses during the summer, and usually betaking itself to the estuaries and sea-coasts in the winter. It is generally an indolent bird, commonly taking its prey by standing in the water until some fish passes close enough to it to be seized by darting out the head. It also feeds upon Frogs, Newts, Crustacea, and Insects, and occasionally upon small birds and quadrupeds. It always swallows its prey entire. It often feeds at night, as is also the case with many of the other species, and the Night Herons (*Nycticorax*, Fig. 154) have received their name from its being supposed that they possessed this habit more decidedly than the rest of the group.



Fig. 155.
Gray Heron (*Ardea cinerea*).

The Bitterns (*Botaurus*), of which three species have occurred in England, also belong to this group. The common Bittern (*Botaurus stellaris*, Fig. 156), which is one of the largest of the genus, measures about thirty inches in length. It was formerly abundant in this country; but since the drainage of many of the marshy districts, it has become less common, and is now rather rare. It feeds at night, and during the day generally conceals itself amongst the rushes, sedges, and reeds which border the marsh-pools; and here it also makes its nest, composed of sticks. The eggs are four or five in number, and the young continue in the nest until fledged. The food of the Bittern is similar to that of the other Ardeinæ, and it seems to be rather voracious, as entire Water Rails have been found in the stomachs of these birds; and Mr. Yarrell states that the stomach of one examined by him contained the bones of a good-sized Pike. When alarmed, the Bittern emits a sharp, harsh cry; but in the spring, and during the breeding season, it produces a loud bellowing sound, to which the name of booming has been given. The most extraordinary stories have been told of this sound, and the mode in which it is produced; according to some ancient authors, the Bittern puts its bill into the soft ground of the marsh, and then produces its bellowing, which is said by them to shake the ground for a considerable distance. This bird wanders pretty generally over the whole eastern hemisphere, being found in summer in the north of Europe and Siberia, and at other seasons in the mild regions bordering the Mediterranean, in India, China, and even in South Africa. Other species are found in different parts of the world.

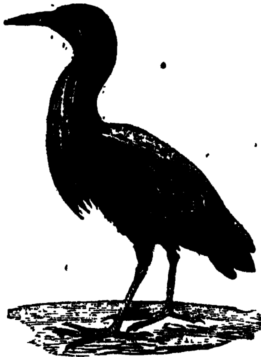


Fig. 156.
Bittern (*Botaurus stellaris*).

Two other remarkable exotic birds belonging to this sub-family deserve to be noticed here. One of these is the Boat-bill (*Cancroma cochlearia*), a bird about the size of a fowl, which is pretty generally distributed in South America. It receives its name from the peculiar form of the bill, which, by some observers, is compared to a boat turned keel-upwards, and by others to the bowls of two spoons placed with their concave sides together. The upper mandible is terminated by a strong hook. The legs of this bird are rather shorter than those of the other members of this group, and it is said to perch upon the branches of trees overhanging the creeks and rivers, so as to dash down upon the fish as they pass beneath it. It appears, however, that the French colonists in Guiana give it the name of *Crabier*, believing that it feeds on crabs.

The other is a very singular bird, from the White Nile, described by Mr. Gould under the name of *Balæniceps Rex*. It resembles *Cancroma* in the form of the bill, which is excessively robust; but the legs are much longer, and the bird is very much larger, measuring no less than fifty-two inches from the tip of the bill to the extremity of the tail. This gigantic bird appears in some respects to be allied to *Cancroma*, and is placed by Mr. G. R. Gray with that genus in the sub-family *Ardeinæ*; in some of its characters, however, such as the reticulation of the tarsi, and the absence of denticulations on the middle claw, it resembles the Storks; whilst Mr. Gould regards it as more nearly allied to the Pelicans.

The next family is that of the *Charadriidæ*, or Plovers, in which the bill is generally about the length of the head, or rather shorter, usually nearly straight, with the basal portion soft and weak, the apical hard, somewhat arched, and more or less pointed at the tip (Fig. 157). The nasal aperture is posterior, and placed in a groove which extends one-half or two-thirds of the length of the bill. The legs are generally very long and slender, with the lower part of the tibiæ bare; the tarsi are reticulated, but often scutellate in front; and the toes are rather small, united at the base by a small membrane, the hidden one (Fig. 158) being very small, and raised from the ground, or entirely wanting. The mouth and œsophagus are narrow, but the gizzard is large and muscular; the cœca are rather long.

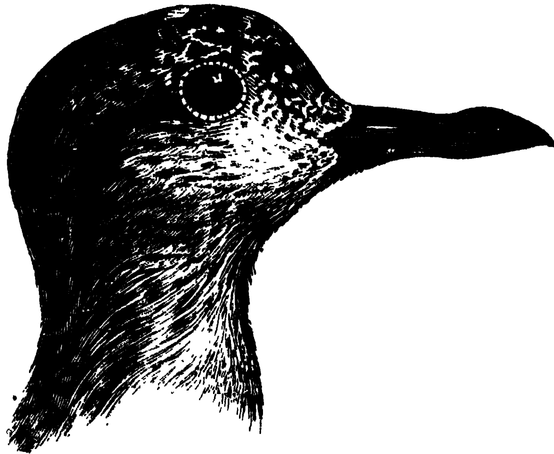


Fig. 157.—Head of Gray Plover (*Squatarola cinerea*)

The Plovers in general are gregarious birds, feeding in flocks. They are less strictly aquatic in their habits than the other families, some of them, indeed, frequenting the margins of rivers, lakes, and ponds, or the sea-shores, whilst others are found upon moors and pastures, and even in ploughed fields Most of them perform considerable migrations, visiting the high northern latitudes during the summer for the purpose of breeding. They generally lay their eggs in a mere cavity in the sand or gravel; and the young run about soon after they are hatched. Several species are found in Britain.

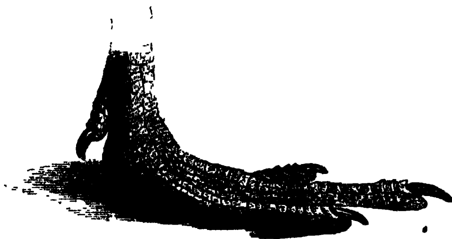


Fig. 158.—Foot of Crested Lapwing (*Vanellus cristatus*).

Amongst these, one of the most remarkable is the *Hæmatopus ostralegus*, or Oyster-catcher (Fig. 159), which forms the type of the sub-family *Hæmatopodinæ*. In this bird the hind toe is wanting; the bill is much longer than the head, slightly bent upwards, pentagonal at the base, and compressed into a thin plate towards the apex, which is abruptly truncated. The Oyster-catcher is a handsome bird, about eighteen inches in length; its plumage is variegated with black and white (whence the name of Sea-pie, which is occasionally applied to it), and its bill is of a bright vermilion or

orange colour. It is found commonly on the coasts, where it wades about seeking its food, which consists principally of Mollusca and young crabs. It is said to detach

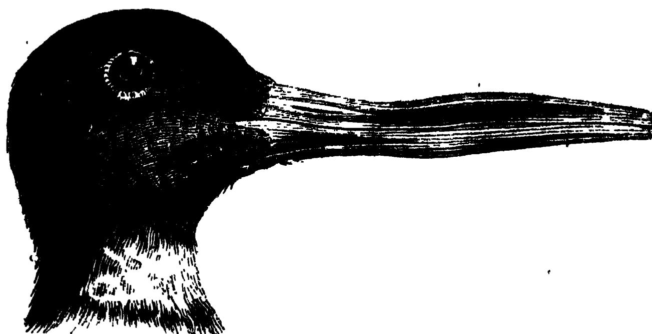


Fig. 159.—Head of the Oyster-catcher (*Hæmatopus ostralegus*).

limpets from the rocks with great facility, and its bill, from its peculiar form, appears particularly adapted for opening large bivalves, such as the oyster, and from this, no doubt, its common English name is derived. It appears, however, that the bird contents itself with the smaller bivalves, which it is able to swallow whole. The Oyster-catcher resides permanently in our islands.

In the *Cinclinæ* the hind-toe is present, but very small; and the bill is shorter than the head, compressed and obtusely pointed. The legs are not very long, and the tarsi are scutellate in front. The British species, *Strepsilas interpres*, or Turnstone, receives its name from the singular manner in which it obtains its food. When walking along the water's edge, it turns over the stones to find the insects and small Crustacea which are commonly to be met with beneath them. It is a handsome bird, of small size, and is met with on the sea-coasts, as well as on the banks of lakes and rivers. It visits us in August, and remains till May, when it departs for its breeding grounds, which are situated in the most northern parts of Europe.

The *Charadrinæ*, including the True Plovers and the Lapwings, have the bill of variable length, and of the form already described in the character of the family. The legs are very slender; the tarsi covered with hexagonal scales, or scutellate in front; the toes rather short and slender, the two outer connected by a basal web, and the hinder one usually entirely wanting, or, when present, reduced to a very small size. These birds are generally found in marshy places, and visit the sea-shores in flocks during the winter. Their flesh is very good, and their eggs are regarded as a great delicacy.

The Pratincoles (*Glareolinæ*), a singular group of birds, are also placed in this family by Mr. G. R. Gray, and by several other authors. Linnæus placed them amongst the Swallows, which they resemble in their forked tails and mode of flight; but he appears to have entertained some doubt as to whether this was really the proper place for the single species known to him, as he says that it appears to be intermediate between the Swallows and the Grallæ. It appears, however, that Linnæus came to this conclusion without seeing the bird, for, in a letter written after he had obtained specimens, he refers it to the Grallæ; and in this he has been followed

by most modern writers on Ornithology, although a few still retain the original opinion of Linnæus.

The Pratincoles have the bill short, arched, and deeply cleft, with the nostrils oblique (Fig. 160); the legs rather long and slender, with the tibiæ feathered for a considerable portion of their length, and the tarsi reticulated; the hinder toe very short, the middle anterior toe long, and furnished with a long claw, the lateral toes shorter, and the outer one united to the middle toe by a small basal membrane. The wings are long and narrow, and the tail usually forked. In their appearance these birds bear some resemblance to the Rasorial birds, and the common European species is called by the French *Perdrix de Mer*, or Sea Partridge, although it is rarely found in the neighbourhood of the coast.



Fig. 160.—Head of the Collared Pratincole (*Glareola pratincola*).

The Pratincoles, according to M. Temminck, who observed the habits of the common species (*Glareola pratincola*) in Hungary, live in warm and temperate climates, frequenting the banks of rivers and lakes, and marshy places. They run and fly with great swiftness, and feed upon aquatic animals, and the insects which live in great numbers amongst the rushes and sedges of the marsh; the latter they often take when on the wing, in the manner of Swallows. They build their nests in thick tufts of reeds, rushes, and other herbage, laying three or four eggs. The species are not numerous, but appear to be pretty generally distributed in the eastern hemisphere; the common species, which sometimes occurs in England, being found in all the warm and temperate regions of the old world.

In the Coursers (*Cursorinæ*), the bill is rather short, slender, depressed near the base, and slightly arched to the extremity; the nostrils are placed on each side of the bill in a short, triangular groove; the legs are long, the tarsi scutellated both in front and behind, and the hind toe is entirely deficient. The Coursers are almost entirely confined to the warmer parts of the old continent, where they commonly frequent the sandy wastes of the interior. Several species are found in different parts of Africa, and one of these, the Cream-coloured Courser (*Cursorius Europæus*, Fig. 161), occurs occasionally in England, and still more frequently in the south of

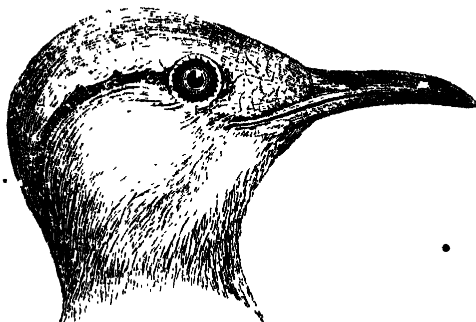


Fig. 161.—Head of the Cream-coloured Courser (*Cursorius Europæus*).

Europe. Little is known of the habits of these birds, except that they run with great swiftness, and appear to pick up their food, probably insects, from the ground. The common species migrates in considerable numbers during the summer, from the interior of Africa to the north coast of that continent; and the few individuals which visit the countries to the north of the Mediterranean, must be regarded as mere stragglers.

The last sub-family of the Charadriidæ is that of the *Œdicneminæ*, or Thick-knees, of which a single species visits this country during the summer. In these birds the basal portion of the bill is depressed and weak, the apical strong and swollen. The nostrils are placed in a deep longitudinal groove, on each side of the bill; the legs are elongated, with the bare portion of the tibiæ and the tarsi reticulated, and the hind toe either entirely deficient or very small, and raised from the ground. These birds, which appear in some respects to unite the Plovers with the Bustards, generally frequent dry pastures and waste places. They are peculiar to the eastern hemisphere, over the warm and temperate parts of which they are pretty generally distributed. One species, the Common Thick-knee (*Œdicnemus crepitans*), which is found abundantly in Asia, Africa, and the south of Europe, visits this country in considerable quantities in the summer; it is especially abundant on the sandy plains of Norfolk, from which circumstance one of its commonest English names is the Norfolk Plover; it is also called the Great Plover, from its considerable size, and the Land or Stone Curlew, from the resemblance of its cry to that of the Common Curlew. They lay their eggs, generally two in number, in a slight hollow in the ground. They are supposed to feed principally at night, or in the twilight; their food consists of worms, slugs, and insects, but they are also said to devour small Mammalia and Reptiles.

In the family *Otididæ*, or the Bustards, the bill is short and stout, rather convex, broad at the base and compressed towards the apex; the nostrils are placed in a large membranous groove, which is clothed with feathers at the base; the legs are elongated and slender, the tarsi reticulated, and the toes short, with convex, obtuse

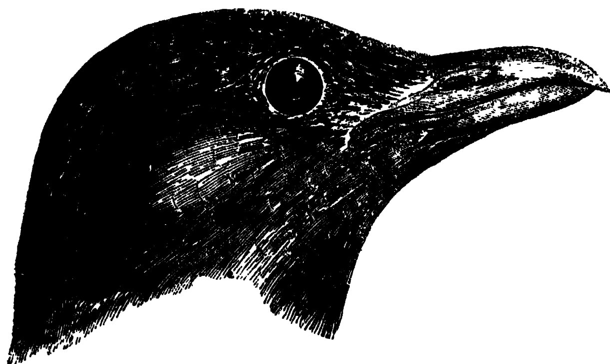


Fig. 162.—Head of the Little Bustard (*Otis tetrax*).

laws. The hind toe is entirely wanting. The wings are ample, and somewhat pointed. The birds of this family have frequently been placed by authors in the order

Cursores, with the Ostriches and their allies, and in some respects they are allied to the Rasorial birds; but their nearest allies appear to be the Coursers and Thick-kneed Plovers, and we have accordingly placed them in juxta-position with these amongst the Grallatores.

The Bustards are generally large birds, which live upon heaths and dry plains in various parts of the eastern hemisphere. They run very rapidly and fly well, although they rise with difficulty. Their food consists principally of worms and insects, with a few reptiles and even small Mammalia, and birds. Green vegetables also appear to constitute a part of their diet. They are generally found at a distance from water, and are said never to drink, although it was long believed that the male of the Great Bustard (*Otis tarda*) possessed a pouch under the throat, in which he conveyed water to the female whilst the latter was engaged in the business of incubation. From the recent observations of Mr. Yarrell, confirmed by other naturalists, it appears, however, that the male Bustard possesses no gular pouch, although the structure of this organ was minutely described by Daines Barrington and Edwards, the latter stating that it opens under the tongue, and that he poured seven pints of water into it before it ran over: Mr. Yarrell therefore concludes that those writers must have mistaken some other bird for the Bustard.—(*Proc. Linn. Soc.*) They are said to be polygamous, and the males take no part in incubation, but retreat to marshy places whilst the females lay and hatch their eggs amongst tall herbage, frequently in corn fields. During the breeding season the males are seen in fine days displaying themselves like Turkey-cocks, spreading their tails, drooping their wings, and dilating their throats.

Two species are found in Britain, but one of these, the Great Bustard (*Otis tarda*), which was formerly very abundant upon the Wiltshire Downs and the Plains of Norfolk, appears now to be nearly extinct in those localities. It is a large bird, the male measuring sometimes nearly four feet in length, and the female about three. In some parts of the continent it is still abundant, and is frequently to be seen in the markets for sale; the flesh of young birds about a year old is said to be very good. The second British species, the Little Bustard (*Otis tetrax*, Fig. 162), is regarded as a straggler, or occasional visitor to our shores; its regular residence being the countries bordering the Mediterranean. Singularly enough, however, it has generally occurred in this country in the winter. It is a much smaller bird than the preceding, measuring only about seventeen inches in length.

The last family of the Grallatorial Birds is that of the *Gruidæ*, or Cranes, composed of large and handsome birds, some of which appear to be allied to the Bustards, and others to the Ardeidæ, in or near which latter family they are placed by some authors. They have the bill strong and sharp-edged, with the nostrils placed in large concave sinuses; the legs long and slender, with a considerable portion of the tibiæ bare, and the tarsi compressed and shielded in front; the toes rather long, with a very small membrane uniting the two outer ones, and the hind toe short and elevated. The wings are broad and the tail short, but the tertiary feathers of the wings are often much elongated, and decomposed into separate filaments, forming tufts of beautiful plumes, which hang down on each side of the tail, and were formerly much worn as ornaments. The birds in which this peculiar structure of the tertiaries prevails, form the sub-family of the True Cranes (*Gruinæ*); they are further characterized by having the bill straight and strong, with both the mandibles of equal length and pointed at the tip. The Cranes are large, stately, and elegant birds, most of which are exclusively inhabitants of warm climates, although some of them undertake con-

siderable migrations. Thus the Common Crane (*Grus cinerea*, Fig. 163) migrates to the north of Europe and Siberia in the spring, remains there and breeds during the summer, and returns southward in the autumn—its winter residence is in Africa and the southern countries of Asia. A few individuals of the Common Crane occasionally visit this country, and in former times the bird appears to have been much more common. It frequents marshy districts, and feeds commonly upon Worms, Insects, Reptiles and Mollusca, but the crop is sometimes found partially filled with grain. The usual situation selected by the Crane for its nest is amongst the reeds, or other tall plants of its marshy abode, but it also occasionally builds upon ruined buildings. During their migrations they fly like the Wild Geese and Swans, either in the form of a wedge, or in a long line, keeping at a considerable elevation, and frequently emitting a loud clear cry; as in the Wild Swan, also, the trachea is very long and convoluted within a cavity of the sternum.



Fig. 163.—Common Crane (*Grus cinerea*).

Amongst the most beautiful species are the Demoiselle, or Numidian Crane (*Anthropoïdes Virgo*), and the Crowned Crane (*Balearica pavonina*), both inhabitants of the northern parts of Africa. The latter is rendered remarkable by the possession of a tuft of flat, yellowish, spirally-twisted filaments, terminated by black pencils, and fringed along the edges with blackish hairs. Both these birds are exceedingly gentle and good-tempered; and as they are easily tamed, and, indeed, are said to take a pleasure in displaying themselves, they form pleasing objects in large aviaries.

In the *Psophinæ*, or Trumpeters, forming the second sub-family of the Gruidæ, the tertiaries are not elongated and decomposed, and the bill is considerably arched towards the apex, with the upper mandible overhanging the lower one at the tip. The birds belonging to this sub-family, which are peculiar to South America, are interesting to the naturalist from the great similarity which they present, in some respects, to the Rasorial or Gallinaceous Birds. One of them, the Trumpeter (*Psophia crepitans*), called the *Agami* by the natives of South America, which is about the size of a large fowl, is common in Guiana, where it is often kept with poultry, which it is said to protect from the attacks of birds of prey. It is exceedingly docile, and attaches itself to the person that feeds it, following him about like a dog; it is said even to attack other domestic animals to prevent them from sharing in its master's caresses. Its name of Trumpeter alludes to a deep, rough sound which it emits. Another species, which is also common in South America, and, like the Trumpeter, may be easily domesticated, is the Cariama (*Cariama cristata*), a bird about the size of a Heron, which is found principally in the mountain plains of Brazil. It flies ill, but runs with great swiftness. It is generally pursued on horseback, and always leads its pursuers a long and tedious chase. This bird feeds upon insects and small reptiles, and, like the Trumpeter, emits a loud, dull cry.

## Order III.—Cursores.

**General Characters.**—Of the Cursorial birds, which have been included by many authors amongst the Grallatores, the common Ostrich is a well-known example. They are nearly all large birds, with strong and generally elongated legs; the wings, on the contrary, are always reduced to a rudimentary condition (Fig. 164), although the bones in number and form agree with those of the wings of other birds. In consequence of this small size of the wings these birds are quite incapable of flight, and the only use they ever appear to make of their wings is to spread them out as if to catch the air in running. In accordance with this deficiency of the power of flight, the bones are almost entirely destitute of the air-cells which in the ordinary birds give so much lightness to the skeleton; and the sternum is reduced to a simple convex shield (Fig. 165), without any trace of the keel, which in other birds gives attachment to the powerful pectoral muscles. To compensate for this deficiency, however, the great size and muscularity of the legs render the pace of these birds in running exceedingly swift; the pelvis is of large size, and the two sides of the arch unite at the pubis, which is not the case in any other birds. The anterior toes are strong, either two or three in number, and terminated by strong nails. The hinder toe is entirely wanting, except in the genus *Apteryx*, in which this organ is present in a rudimentary condition.

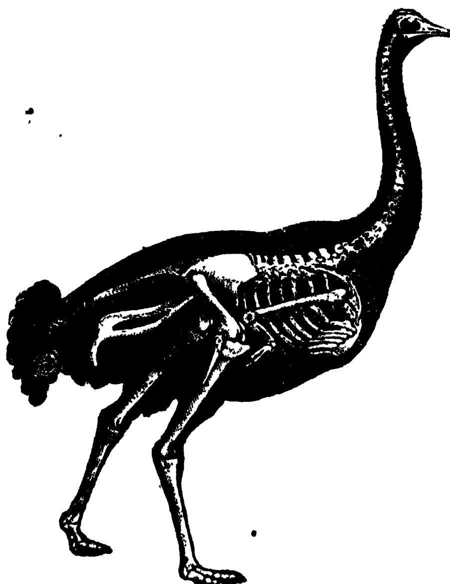


Fig. 164.—Skeleton of the Ostrich

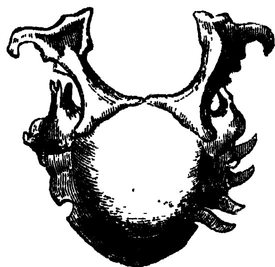




Fig. 165.—Sternum of the Emeu (*Dromaius Novæ Hollandiæ*).

The plumage is of a very peculiar character, the barbs of the feathers being always separate, and often exhibiting a close resemblance to hairs. The bill is usually rather short, depressed, and

somewhat triangular; but in the *Apteryx* it is elongated and cylindrical, with the nostrils placed at the tip. The head and neck are usually naked, or covered only with a short, downy plumage; the head is sometimes furnished with a horny crest, and the neck with fleshy wattles.

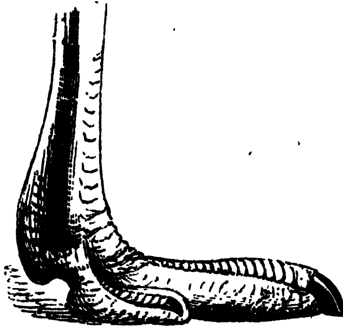


Fig. 166.—Foot of the Ostrich (*Struthio camelus*).

These remarkable birds, of which very few species are known, are confined to the warmer parts of the earth,—one species being found in tropical Africa, another in the Islands of the Eastern Archipelago, a third in New Holland, and a fourth in South America. The singular genus *Apteryx*, of which two species have been described, is confined to New Zealand.

**Divisions.**—The order includes only two families. In the typical family of the *Struthionidæ*, or Ostriches, which includes the largest of known birds, the bill is broad, depressed, and triangular, with the apex obtuse, and the nostrils placed in a groove, and the hinder toe is entirely deficient. The legs are very long, especially the tarsi, which are covered with scales. The plumage varies considerably in its texture in the different species, which all frequent the desert plains of the countries inhabited by them, where they run with great swiftness.

The best known species is the Ostrich (*Struthio camelus*, Fig. 167), the largest of all existing birds, which inhabits the sandy deserts of tropical Africa. This remarkable bird, which has been celebrated since the most remote antiquity, measures from six to eight feet in height; its feet consist only of two toes (Fig. 166), its head and neck are nearly naked, the general plumage is very lax, and the quill feathers of the wings and tail are particularly remarkable for the length of their barbs, which, although furnished with barbules, are completely separate from each other: these are the well-known Ostrich-feathers, which from their elegance are so highly prized as ornaments.

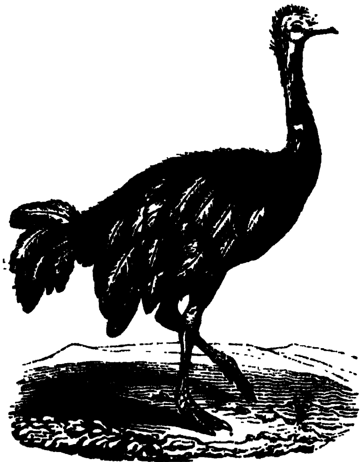


Fig. 167.—Ostrich (*Struthio camelus*).

The Ostriches live together in large flocks, feeding upon grass, grain, &c.; like the Gallinaceous birds, which they resemble in their food, they have an enormous crop and a strong gizzard. In confinement, however, they appear to devour indiscriminately almost anything that comes in their way, as they have been frequently known to pick up and swallow pieces of leather, wood, stones, and even metal. The hard substances are probably taken to assist the action of the gizzard; but however this may be, the voracity of the Ostrich formerly gave rise to a belief that this bird fed upon iron.

The African Ostrich is polygamous. The female scratches a hole in the sand, in which she lays ten or twelve eggs, and these are hatched principally by the heat of the sun, although the female, contrary to a very generally received opinion, watches over them with great care, and sits upon them during the night. The eggs weigh about three pounds, and are regarded as a great delicacy. When pursued, the Ostrich runs with such rapidity as speedily to outstrip the swiftest horse, and the hunters, therefore, either relieve one another in the chase, or bewilder the bird by approaching it in several directions; but the pursuit is not always unattended with danger, as the Ostrich sometimes attacks his enemies, striking out with his feet with great force. In captivity this bird often becomes tame and gentle with those to whom it is accustomed, but almost always exhibits more or less enmity towards strangers, whom it will endeavour to knock down and trample under foot.

The American Ostrich (*Rhea Americana*), called also the Nandou, or Rhea, is scarcely more than half the size of the African species, from which it also differs in having the head covered with feathers, and the feet furnished with three toes. It is of a nearly uniform gray tint, and the feathers of the wings and tail, although elongated, possess none of the beauty of those of the True Ostrich; they are only employed in the manufacture of light dusting brooms. It is very abundant in the great plains of tropical America, where it is pursued on horseback, and captured either by the lasso, or by throwing at its legs an instrument formed of two heavy balls, or stones, attached together by a leathern thong. Mr. Darwin, who had frequent opportunities of observing these birds, has given an excellent account of their habits. He says that the Ostriches take the water readily, and swim across broad and rapid rivers, and even from island to island in bays. They swim slowly, with the greater part of their bodies immersed, and their necks extended a little forwards. According to the late Earl of Derby, these birds are polygamous; and the male bird prepares the nest, collects the eggs, which are frequently laid by the females at random on the ground, and performs all the duties of incubation. Mr. Darwin confirms these observations, and says that four or five females have been seen to lay in the same nest, and that the male when sitting lies so close that he himself nearly rode over one. At this time the males are said sometimes to be very fierce, and they have been known to attack a man on horseback, trying to kick and leap on him.

The Emeu of New Holland (*Dromaius Novæ Hollandiæ*) is nearly as large as the African Ostrich, measuring from five to seven feet in height. It has three toes in each foot, and these are furnished with nearly equal claws; the head is covered with feathers, but the throat is naked, and the plumage of the body closely resembles long hairs, hanging down on each side of the body from a central line, or *parting*. The neck is covered with feathers. These birds are abundant in the southern parts of Australia; but in the more populous parts of the British colonies there they are now extinct. They are much sought for, both by natives and Europeans, for the sake of their flesh, that of the young birds being described as very delicate, whilst that of the old ones is compared to beef. Their eggs also are eaten; and it is said that during their breeding season the natives of some parts of Australia live almost entirely upon Emeu's eggs. The old birds are hunted by trained dogs, which have been taught to avoid the powerful kicks of their quarry by running up alongside of the bird and then springing suddenly upon its neck. They are monogamous, and the males, as in the case of the Rhea, perform the duties of incubation. The eggs are nearly as large as those of the Ostrich, but of a dark green colour;

and the young, when first hatched, are rather elegantly striped with black and whitish gray.

The last species of this family is the Cassowary (*Casuarius galeatus*, Fig. 168), an inhabitant of the islands of the Eastern Archipelago. It stands about five feet in height, and is distinguished generically from the other members of the family by the possession of a peculiar horny crest or helmet upon the head, by the wings being furnished, instead of feathers, with about five cylindrical stalks destitute of barbs, and by the large size of the claw on the inner toe. The head and neck are naked and wattled, and these parts are of a bright red colour, variegated with blue. The rest of the body, which is very stout, is covered with long pendent feathers, which resemble hair even more closely than those of the Emeu. It feeds upon fruits, herbage, and seeds, and, like the Ostrich, swallows hard substances, probably to assist the action of the gizzard. The eggs are of a greenish tint.

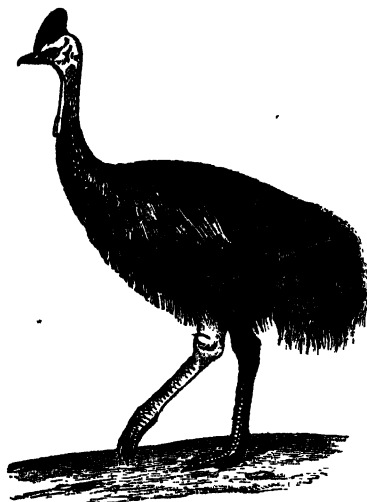


Fig. 168.—Cassowary (*Casuarius galeatus*).

The eggs and some of the bones of a gigantic bird belonging to this family, the *Æpyornis maximus*, have been recently discovered in the island of Madagascar. The largest of the eggs, which were found imbedded in alluvial soil, measured no less than twelve inches and two-thirds in length, whilst the egg of the Common Ostrich is only about half this size. The difference in the contents of the two eggs is much greater, for M. Isidore Geoffroy Saint-Hilaire, who was the first describer of these extraordinary remains, calculates that the largest egg of the *Æpyornis* received by the Paris Museum would contain 10⅛ quarts, or about as much as 6 eggs of the Ostrich, 16 of the Cassowary, or 148 of the common Hen. One of the eggs had been perforated by the natives, and used as a vessel for carrying water. From the dimensions of the bones, it is supposed that this bird must be at least double the size of the Ostrich; and it appears not improbable that it may still be in existence in the interior of the almost unknown island in which its remains were found.

Another group of gigantic extinct birds is also placed in the immediate neighbourhood of the Struthionidæ by some authors, but distributed by others between these and the Grallatores. These are the *Dinornidæ*, the bones and even the eggs of which have been found in considerable quantities imbedded in the volcanic sands of New Zealand.

Several species have been distinguished, amongst which the *Dinornis giganteus* was pre-eminent in stature. It has been calculated that this bird must have been at least fourteen feet in height. It appears exceedingly probable that these birds, if they do not still exist in the more inaccessible parts of the islands of New Zealand, were inhabitants of that distant land when it was first peopled with human beings, as the traditions of the natives describe a gigantic bird, to which they give the name of *Moa*, with

which their ancestors are said to have waged a war of destruction. The natives showed one traveller the place where the last *Moa* was destroyed after a tremendous battle, in which several of its assailants were killed. The egg of one of these birds was discovered by Mr. Walter Mantell, who describes it as so large that his hat would but just serve as an egg-cup for it; it would, therefore, appear to be nearly as large as that of the *Æpyornis*.

The second family of the Cursores, the *Apterygidæ*, includes only two singular wingless birds, inhabitants of New Zealand. These birds are distinguished from the Struthionidæ by the elongated slender form of the bill, which bears the nostrils at the tip of the upper mandible, by the comparative shortness of the legs, and the presence of a short hind toe, furnished with a strong claw. The wings are perfectly rudimentary, and concealed under the feathers, which resemble those of the Emeu.

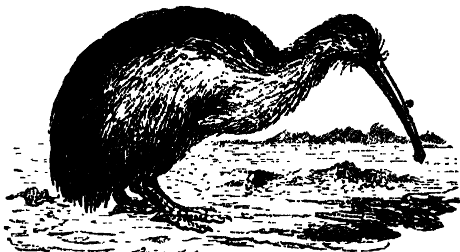


Fig. 169.—The Apteryx.

These birds are nocturnal in their habits, feeding upon insects, running with great rapidity, and defending themselves vigorously with their feet. The name of *Kiwi-Kiwi* is given to them by the natives of New Zealand, who use the skin in making dresses, which are highly valued. A specimen of one of the species is now living in the Zoological Gardens.

## Order IV.—Rasores.

**General Characters.**—This order includes the numerous species of Gallinaceous birds, or those which agree more or less in structure with our common Fowl, and the name *Rasores*, or Scrapers, alludes to the habit of scratching in the ground in search of food, which, as every one knows, is so common with domestic poultry.

These birds are generally of moderate size, with the body rather stout, and the neck short, or of moderate length. The head is rather small, and the bill, which is usually shorter than the head, is more or less arched, and has the upper mandible projecting beyond the lower one both at the apex and the margins. The legs are of moderate length, but usually very stout; the tibiæ are feathered quite down to the tip; and the feathers, in some cases, cover the tarsi, and even the toes. The anterior toes are always three in number, usually rather short, stout, furnished with broad, blunt nails, and frequently more or less united by a web at the base; the hinder toe is usually small, and raised a little upon the back of the tarsus, but in the species which frequently perch upon trees, and some others, the hinder toe is more elongated, and placed on the same level with the rest. The back of the tarsus is also frequently furnished, especially in the males, with one or more spurs, which are often of considerable length, and constitute formidable offensive weapons in the combats which prevail amongst these birds during the breeding season.

The plumage is firm, and the accessory feathers, or plumules, are always of large size. The birds, and especially the males, are frequently adorned with magnificent colours; and in many cases particular parts of the plumage in this sex acquire a great

degree of development, rendering the appearance of the birds exceedingly elegant. The wings are usually short and weak, and the flight of the birds by no means powerful or prolonged; it is generally accompanied by a whirring sound, which is almost characteristic of this order.

The general conformation of the digestive organs (Fig. 117) is as follows:—The œsophagus is narrow, but is dilated below the middle into a large, somewhat globular crop. The stomach, or gizzard, is exceedingly strong and muscular, and lined with hard, tendinous plates, by the action of which, assisted in most cases by stones, or other hard substances which the birds swallow, the comminution of the food is effected. The intestine is long, and furnished with very large cœca; the latter organs, in fact, are larger in these than in any other birds.

These birds are found in all parts of the world, from the tropics to the frozen regions of the north; but the finest and most typical species are inhabitants of the temperate and warmer parts of Asia. They feed principally on seeds, fruits, and herbage, but also, to a considerable extent, on insects, worms, and other small animals. Their general habitation is on the ground, where they run with great celerity, but many of them roost on trees. They are mostly polygamous in their habits, the males being usually surrounded by a considerable troop of females; and to these, with one remarkable exception, the whole business of incubation is generally left. The nest is always placed on the ground in some sheltered situation, and very little art is exhibited in its construction—indeed, an elaborate nest is the less necessary, as the young are able to run about and feed almost as soon as they have left the egg; and at night, or on the approach of danger, they collect beneath the wings of their mother.

**Divisions.**—The Rasorial birds form seven families. In the Tinamous (*Tinamidæ*), the bill is rather straight, with the base covered with a membrane, and the tip suddenly hooked. The wings are short and concave; the tail short, or entirely wanting; the tarsi are scutellate in front, and the toes long,—the hinder one being sometimes wanting. The genus *Tinamotis*, belonging to this family, makes a very near approach to the Bustards.

These birds are peculiar to South America, where they live in the fields, or on the borders of woods. Their flight is heavy; but they run with considerable swiftness. They feed principally upon grain, visiting the newly-sown fields of corn and maize during the night, to pick up the seeds which have not been covered by the soil. The females lay about seven eggs, in tufts of herbage; and the young, when hatched, soon disperse, the family being rarely found united into a flock. Their flesh is exceedingly good; and as they do not rise willingly, but rather prefer endeavouring to conceal themselves when pursued, they are taken without much difficulty by means of a noose at the end of a stick. They vary considerably in size, the largest species being about as large as a pheasant, or from fifteen to eighteen inches in length, whilst the smallest do not exceed six inches.

The *Chionididæ* have the bill rather short and stout, compressed and much arched towards the tip; the nostrils are placed at the base, and protected by a horny sheath or covering. The wings are long and pointed, and the tail of moderate size; the tarsi are short and stout, the anterior toes long, united at the base, and the hinder one small and elevated. The best known species of this family is the White Sheathbill (*Chionis alba*), a bird about fifteen inches in length, of a white colour, with the feet reddish-black. It frequents the shores of Australia, New Zealand, and other islands approaching the Antarctic ocean, where it feeds upon Mollusca and other animal

matters, resembling some of the Wading birds so closely in its habits, that it has been placed amongst them by many naturalists.

It is probable that it occasionally feeds upon carrion, as Forster, its original describer, states that, having killed some of them in Cook's second voyage, the sailors were unable to eat the flesh in consequence of its abominable odour; although, as he observes, they were not at that time particularly nice in the choice of food. M. Lesson and Messrs. Quoy and Gaimard, however, found the flesh particularly good; and in Cook's third voyage it is said to be equal to Duck.



Fig. 170.—Foot of the Black Cock (*Tetrao tetrix*).

In the family of the *Tetraonidæ*, or Grouse, the bill is rather short, broad at the base, compressed and arched, with the tip obtuse; the nostrils are placed at the base of the bill, sometimes covered with feathers, or protected by a hard scale; the legs are stout, with the tarsi usually naked and scutellate, but sometimes clothed with feathers to the toes (Fig 170). The hind toe is rarely wanting, usually rather small and elevated. The wings are generally short and rounded, and the tail is also rounded at the extremity.

This family, which includes a great number of species, is divided into four subfamilies. The *Tetraoninæ*, including the typical species, have the bill short, very broad at the base, and gradually narrowed and compressed towards the tip; the nostrils are clothed with small feathers, as are also the tarsi, and sometimes even the toes. These birds live principally upon the ground, where they run with great swiftness, and feed almost entirely upon vegetable substances—such as berries, seeds, and the buds of trees and shrubs. They are generally found in mountainous districts, some living on open heaths, whilst others prefer wooded spots. They vary greatly in size, the largest being nearly as large as a Turkey, the smallest scarcely exceeding a Pigeon in size.

One of the largest species is the Capercailzie, or Wood Grouse (*Tetrao urogallus*), which was formerly an inhabitant of the Highlands of Scotland, but has now been extinct there for many years. Although some tolerably successful attempts have recently been made to introduce it again, the imported birds and their progeny can hardly be regarded as true natives. This bird measures about three feet in length from the tip of the bill to the end of the tail; the male is delicately mottled with gray and brownish-black, with the front of the neck and breast black, tinged with a glossy green; whilst the female is variegated with yellowish-brown, white and brownish-black. The Capercailzie is found abundantly in the pine forests of Scandinavia, where it feeds principally upon the leaves and tender shoots of the Scotch fir (*Pinus sylvestris*). In the spring, even before the snow has disappeared, the breeding season of the Capercailzie commences; the cock bird selects a place, where he displays himself, spreading his tail, and ruffling his feathers in the manner of a turkey-cock, uttering at the same time a call which is described as resembling the *peller; peller, peller*, repeated with gradually increasing rapidity, and concluding with a sort of gulp and drawing in of the breath. "During this latter process," according to Mr. Lloyd, "the head of the Capercali is thrown up, his eyes are partially closed, and his whole appearance would denote that he is worked up into an agony of passion." The hens, on

hearing the call of the cock, assemble from all the neighbouring parts of the forest, when the cock bird descends from his perch and joins their company. The cock birds generally resort to some particular station, so that, according to Mr. Lloyd, the call may be heard in the same place every spring for years together. The old males are very jealous of the younger members of the community, and will never suffer them to play or call, and frequent combats take place between them in consequence. The hens form their nests on the ground, and lay from six to twelve eggs; the cocks take no share in the process of incubation, which is said to occupy four weeks. In captivity, the Capercailzie is easily domesticated, and appears to breed pretty readily when placed in favourable conditions. The cocks will frequently peck at the legs of people walking in the place where they are kept, and even in a state of nature they are sometimes known to attack intruders on their favourite haunts. They are taken principally in traps, and considerable numbers are sent from Norway to the London market.

Of the truly British species the finest is the Black Cock (*Tetrao tetrix*, Fig. 171), which is found in small numbers in some parts of England, and is tolerably abundant in Scotland. The male is of a fine glossy black colour, with the lower wing coverts, the under tail coverts, and the bases of the secondary quills white. The form of the tail, however, is one of the most remarkable characters in the male bird, the four outer feathers on each side being considerably elongated and strongly curved outwards at the tip, so that the tail has the appearance of a double hook. In the female, the tail is straight, and the colour is pale, barred, and mottled with dark brown. In its habits the Black Cock closely resembles the Capercailzie, generally inhabiting low districts in the neighbourhood of woods, and feeding principally upon the twigs of heath, with the young shoots of other shrubs and trees, seeds, and berries. In winter, according to Mr. Yarrell, the crop is often filled with the young shoots of firs, and in the autumn the bird sometimes frequents corn-fields.

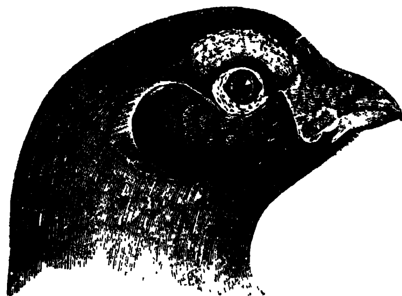


Fig. 171.—Head of Black Cock (*Tetrao tetrix*).

Several allied species are found in the United States of America. One of these, the Ruffed Grouse (*Bonasia umbellus*), which is called the Pheasant in the United States, has on each side of the neck a large tuft of black or brown feathers, which it has the power of raising at pleasure. This bird is found in all parts of the States, but is most plentiful in the mountainous districts, where it lives in the woods, and appears to resemble the Capercailzie in its habits, the male displaying himself in the same manner during the breeding season, and emitting a loud drumming noise as a call to the females. The Ruffed Grouse measures about eighteen inches in length, and furnishes an exceedingly delicate food. The most remarkable of the American species is the Pinnated Grouse (*Tetrao cupido*), which is found, although rarely, in many parts of the United States. The male of this singular bird measures about nineteen inches in length; it has a pair of curious wing-like organs, about three inches long, attached one on each side of the neck; and below these, on each side, a wrinkled bag, which is capable of

being inflated, and then, as described by Wilson, "resembles, in bulk, colour, and surface, a middle-sized orange;" the head is furnished with a small crest, and over each eye there is an elegant, semicircular comb, of a rich orange colour, which the bird has the power of raising or depressing at pleasure. During the season of their amours the male bird produces a peculiar sound, which is called *tooting* by the American sportsmen, from its resemblance to the sound of a distant horn; and although this call does not appear to be very loud when in the vicinity of the bird, it is said to be audible at a great distance—from three to six miles according to different observers.

A remarkable habit of these birds is thus described by Dr. Mitchell, in Wilson's American Ornithology:—"During the period of mating, and while the females are occupied in incubation, the males have a practice of assembling, principally by themselves. To some select and central spot, where there is very little underwood, they repair from the adjoining district. From the exercises performed there, this is called a *scratching-place*. The time of meeting is the break of day. As soon as the light appears, the company assembles from every side, sometimes to the number of forty or fifty. When the dawn is past, the ceremony begins with a low tooting from one of the cocks;—this is answered by another. They then come forth one by one from the bushes, and strut about with all the pride and ostentation they can display. Their necks are incurvated; the feathers on them are erected into a sort of ruff; the plumes of their tails are expanded like fans; they strut about in a style resembling, as nearly as small may be illustrated by great, the pomp of the Turkey-cock. They seem to vie with each other in stateliness; and, as they pass each other, frequently cast looks of insult, and utter notes of defiance. These are the signals for battles. They engage with wonderful spirit and fierceness, leaping a foot or two from the ground, and uttering a cackling, screaming, and discordant cry."

Occasionally, however, these exhibitions of pride receive rather an unpleasant interruption; for the hunters often find out the scratching-places, and, by concealing themselves over-night, with their guns, in huts of pine branches, within a few yards of the spot, deal wholesale destruction upon the unfortunate birds, whilst these are engaged in strutting about or fighting.

Their flesh is considered particularly delicate, and they have been destroyed in such numbers, notwithstanding legislative enactments for their preservation, that, in Wilson's time, they had advanced in price from one dollar to four or five dollars a pair.

In the Common Grouse, or Ptarmigans (*Lagopus*), the feathers extend to the extremity of the toes (Fig. 172). These birds are found only in the colder temperate regions of the northern hemisphere, and generally in mountainous districts. They live entirely on the ground, and feed, like the preceding species, upon the twigs and leaves of plants, seeds and berries; but, unlike these, they are not polygamous, the males and females pairing and remaining together during the breeding-season. The common species, or Red Grouse (*Lagopus scoticus*), which is peculiar to these islands, inhabits heathy districts at almost any elevation, and feeds to a great extent upon the young shoots of the heath; the Ptarmigan (*L. vulgaris*), on the contrary, is an inhabitant of the highest parts of mountains, and only descends towards



Fig. 172.—Foot of the Common Grouse (*Lagopus scoticus*).

the lower regions during the winter. The Red Grouse is of the same colour all the year round; but the Ptarmigan acquires a white plumage in the winter. Both these



Fig. 173.—Ptarmigan (*Lagopus vulgaris*).

species, but especially the former, are great favourites with sportsmen, and the number killed every autumn is enormous. The Ptarmigan is found on most of the high mountains of Europe, even as far south as Spain and Italy; but it is most abundant in

the northern countries, and a considerable number are brought to this country from Norway. It also occurs in the most northern parts of America.

The *Odontophorinæ* are distinguished by having two teeth on each side of the lower mandible, near the point. The bill is short, and arched towards the tip, with the apex of the upper mandible prolonged beyond the lower one; the nostrils are situated at the base of the bill, in a short rounded groove, and covered by a membranous scale; the wings are concave and rounded, the tarsi elongated and slender, and the toes long, the outermost being longer than the inner. These birds are inhabitants of America, where they take the place of the Partridges and Quails of the eastern hemisphere, and are generally known by the same names. The best known species is the American Quail (*Ortyx virginianus*), a bird about nine inches in length, which is found in all parts of North America, and as far south as Honduras. These birds, which are as much the objects of pursuit with the American sportsmen, as the common Partridge with those of our own country, are generally found about the plantations, where they feed upon grain. They occasionally seek shelter in woods, but usually keep in the open fields, concealing themselves amongst the briers of hedge-banks. In May, the females make a nest of dry grass and herbage on the ground, and generally protected by a large tuft of grass. In this they lay from fifteen to twenty-four eggs, and the young quit the nest as soon as they are hatched, running about with their mother in search of food. When disturbed under these circumstances, the mother immediately puts every artifice in practice to lure the intruder away from her helpless brood, running along the path before him with her wings dragging on the ground, as if severely wounded, and returning by a circuitous route when the danger has been eluded, to collect the chicks, which, in obedience to the first note of alarm, have secreted themselves amongst the herbage. When the eggs are hatched under a common hen, the young birds are perfectly contented with their captivity until the approach of Spring and the breeding-season, when they invariably take their departure. Another species, the Californian Quail (*Ortyx californicus*), has the top of the head ornamented with several remarkable curved feathers.

In the *Turnicinæ*, the bill is of moderate size, nearly straight, with the tip of the upper mandible slightly overhanging that of the lower one; the nostrils are placed in a groove which extends beyond the middle of the bill; their aperture is linear and furnished with an elongated scale. The tarsi are of moderate length, and stout; the toes, usually three in number, rather long, and free at the base; the wings short and rounded, and the tail nearly concealed by the dorsal feathers.

These small birds, which are pretty generally distributed over the eastern hemisphere, present a considerable resemblance to the Bustards in their general appearance. They live generally on barren deserts, where they run with great celerity, and when disturbed, generally conceal themselves in the taller herbage, or endeavour to escape by running, but rarely take to flight. They feed upon seeds and insects, and are said to be polygamous, but little is known of their habits. Only a single species is found in Europe, the Andalusian Quail (*Turnix tachydromus*), and this is especially a native of the countries bordering on the Mediterranean, both in Europe and Africa. It is considered by Temminck to be a migratory bird, and specimens have occasionally strayed so far to the north as to reach this country. Several species are found in India and the islands of the Eastern Archipelago, and Mr. Gould has brought seven or eight from Australia. The last-named ornithologist confirms Temminck's opinion as to the migrations of these birds. A Javanese species, *Turnix*

*pugnax*, is of an exceedingly quarrelsome disposition, and is much sought after by the natives of that island, who amuse themselves with its combats.

The last sub-family is that of the *Perdicinæ*, including the Partridges and Quails, in which the bill is short and compressed, with the margins of the mandibles entire,

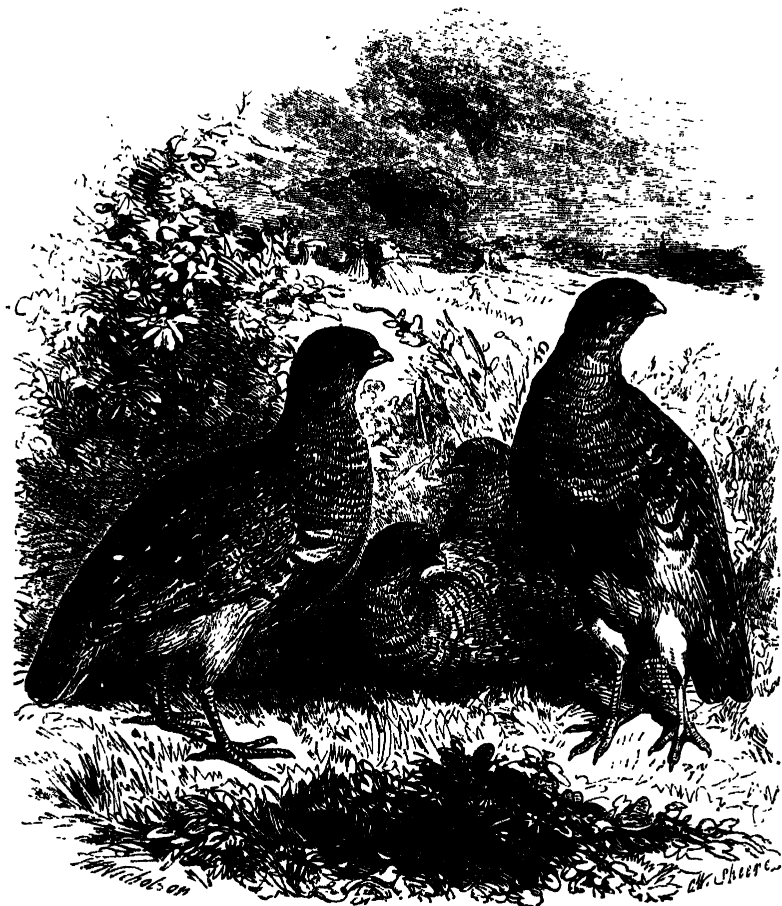


Fig. 174.—The Common Partridge (*Perdix cinerea*).

and the nostrils protected by a hard scale; the tarsi are elongated, covered in front with scales, and occasionally armed with spurs or tubercles, and the hinder toe is more or less elevated. The Perdicinæ are very generally distributed over the temperate and warmer regions of the eastern hemisphere. Some, like our common Partridge, are stationary, whilst others, such as the Quails, perform regular migrations. They live

principally upon the ground, in pastures, especially in mountainous districts, and in corn-fields; a few inhabit rocky places, and some are even found in woods. They feed principally upon seeds, berries, and buds. The nest is of a very simple nature, and generally placed on the ground in a small hollow; the eggs are numerous, and the young run about from the moment of their leaving the egg, in company with the mother, who often employs a stratagem, similar to that related of the American Quail, to save her young from danger.

Of the true Partridges (*Perdix*) two species are found in Britain; one of them, the Common Partridge (*Perdix cinerea*, Fig. 176), is an undoubted native; but the second, the Red-legged or Guernsey Partridge (*Perdix rubra*, Fig. 175), although not uncommon in some localities, is well known to have been introduced from the continent. These well-known birds are found principally about corn-fields, but the Guernsey Partridge also frequents heathy places. Their food consists of grain and seeds, together with tender herbage and insects. During the autumn and winter, they keep together in small flocks, called *coveys;* but early in the spring they separate and pair, although the eggs are rarely laid before the month of June. The nest consists of a hollow scraped in the ground, generally in some sheltered situation, and lined with a few straws. The eggs vary from ten to fifteen in number, and the whole work of incubation is left to the female, although the male always remains close to the nest, endeavouring to protect his mate from danger either by stratagem or fighting. When the young are hatched, they are attended to by both parents, who often expose themselves to danger for the protection of their helpless brood. To show the courage sometimes evinced by these birds with this object, Mr. Selby relates the following anecdote:—


Fig. 175.—Head of Red Partridge (*Perdix rubra*).

"A person engaged in a field not far from my residence, had his attention arrested by some objects on the ground, which, upon approaching, he found to be two Partridges, a male and female, engaged in battle with a Carrion Crow; so successful and absorbed were they in the issue of the contest, that they actually held the Crow till it was seized and taken from them by the spectator of the scene. Upon search, the young birds, very lately hatched, were found concealed amongst the grass. It would appear, therefore, that the Crow, a mortal enemy to all kinds of young game, in attempting to carry off one of these, had been attacked by the parent birds, and with this singular result."


Fig. 176.—Head of Common Partridge (*Perdix cinerea*).

The Francolins (*Francolinus*) closely resemble the Partridges, but the tarsi of the males are armed with one or two spurs. They differ considerably from the True Partridges in their habits, living in damp places, in woods and forests, and perching constantly upon trees. One species, the common Francolin (*F. vulgaris*) is an inhabitant of the south of Europe, Asia, and the north of Africa. Like the Common Partridge, which it resembles in the form of its bill, it feeds upon insects and seeds; but some of the African species derive their nourishment from bulbous plants, and to enable them

to dig these out of the ground, the bill, especially the upper mandible, is considerably elongated. Their flesh is very good.

The Quails (*Coturnix*) also resemble the Partridges in their general form, but the head does not present the bare space behind the eyes which is characteristic of those birds. The Quails are all small birds, the common species (*Coturnix dactylisonans*), which is a summer visitor to this country, not exceeding eight inches in length. They are confined to the eastern hemisphere, over which they are generally distributed, and some, if not all of them, are migratory in their habits. They are said to be polygamous, but this is rather doubtful, as the male is observed to assist the female in the care of her brood. It is certain, however, that the males are excessively pugnacious, and in some countries they are kept in confinement for the sake of the sport afforded by their combats. In their general habits and food, the Quails resemble the Partridges.

In the family of the *Pteroclidæ*, or Sand Grouse, the bill is rather short, compressed, nearly straight, and curved at the tip, with the nostrils at the base, and half closed by a membranous scale. The tarsi are rather long, and covered in front with small feathers; the toes short, especially the hinder one, which is nearly rudimentary, and placed high up upon the tarsus. The wings and tail are elongated and pointed, and in some species the two middle feathers of the tail are considerably longer than the others. These birds live for the most part on the plains and sandy deserts of the hot countries of the old world.

Two species (*Pterocles arenarius* and *P. alchata*) are found in Europe, but these frequent only the most southern parts of the continent. They fly well, and often perform long journeys, although they cannot be regarded as migratory birds; their food consists principally of seeds and insects. They nidificate on the ground, amongst stones or herbage, and lay four or five eggs.

The fifth family, that of the *Phasianidæ*, or Pheasants, includes the most beautiful of the Rasorial birds; indeed, some of them may perhaps be justly regarded as pre-eminent in this respect over all the rest of their class. In these birds the bill is of moderate size and compressed, with the upper mandible arched to the tip, where it overhangs the lower one; the tarsi are of moderate length and thickness, usually armed with one or two spurs; the toes are moderate, and the hinder one short and elevated. The wings are rather short and rounded, and the tail more or less elongated and broad, but frequently wedge-shaped and pointed. The head is rarely feathered all over; the naked skin is sometimes confined to a space about the eye, but generally occupies a greater portion of the surface, occasionally covering the whole head, and even a part of the neck, and frequently forming combs and wattles of very remarkable forms. In some species the crown is furnished with a crest of feathers.

The birds of this family are for the most part inhabitants of the Asiatic continent and islands, from which, however, several species have been introduced into other parts of the globe. The Guinea Fowl of Africa, and the Turkeys of America, are almost the only instances of the occurrence of wild Phasianidous birds out of Asia. Some species, such as the common Fowl, the Peacock, the Turkey, and the Guinea Fowl, have been reduced to a state of complete domestication, and are distributed pretty generally over the world.

The Phasianidæ constitute four distinct sub-families. In the *Meleagrinæ*, or Turkeys, the tail is short and pendent in repose, and the head and neck are naked and covered with a carunculated skin. This sub-family includes only the Turkeys and

Guinea Fowl of America and Africa, representatives of which are well-known denizens of our poultry-yards. The common Turkey (*Meleagris Gallopavo*, Fig. 177) in its wild state still exists, although in greatly diminished numbers, in the most unfrequented parts of the North American continent. It measures about three feet and a-half in length, and is rather a handsome bird, the general colour of its plumage being black, glossed with purple and bronzed green, and the quill feathers variegated with white. The head and neck are covered with a bare carunculated skin, and at the base of the bill there is a singular fleshy appendage, which is usually of considerable length. The breast is ornamented with a tuft of long black hair. In the wild state the Turkeys feed upon grain of all sorts, berries, fruits, grass, and insects; they collect in parties of variable number, and often journey from one part of the country to another in search of some favourite description of food.

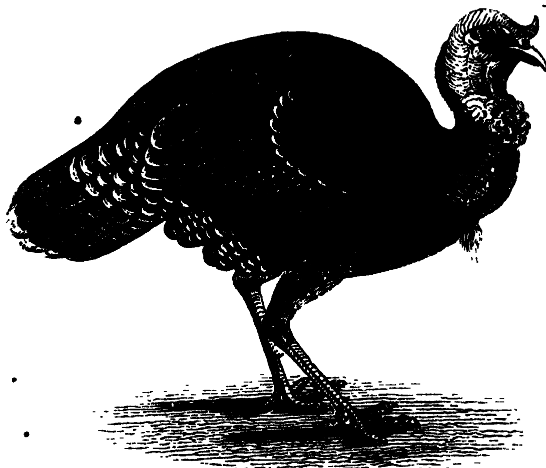


Fig. 177.—Turkey (*Meleagris Gallopavo*).

The old males form parties separate from the females, which also collect into flocks with their young; and these always endeavour to avoid the old males, who take every opportunity of killing their younger brethren. When moving from one place to another their course is frequently interrupted by rivers, when they collect on the highest part of the bank, and generally remain for a day or two, apparently in consultation as to the best mode of getting over the obstacle, the old males strutting about and *gobbling* with the greatest importance, as if to inspire their weaker and more timid companions with the necessary courage. Before attempting the arduous and dangerous undertaking, the whole flock mounts to the tops of the highest trees on the bank, and then simultaneously takes flight towards the opposite shore. The stronger ones get over without difficulty; but many of the younger and weaker individuals are unable to support themselves across a wide river, and, falling into the water, are compelled to swim for their lives, spreading out their tails and striking out with their feet. In this manner they usually succeed in making the shore; but sometimes, when the bank is steep, a good many, which are unable to quit the water, are carried away by the stream and drowned.

They are polygamous, and during the breeding season the males exhibit themselves before the females, strutting about with their tails spread, their wings drooping, their feathers ruffled, and their heads and necks drawn far back; at these times, the males utter at intervals a singular sound, which closely resembles the word *gobbler*, several

times repeated. During this period of their amours, the males never meet without a desperate combat, which frequently terminates in the death of the vanquished, and they are said to endeavour to destroy the eggs laid by the females, in order to prolong their honeymoon as much as possible. The females form a simple nest of a few dry leaves, in some dry sheltered situation, and lay in it a considerable number of eggs (usually from ten to fifteen); the males then quit them, and conceal themselves in thickets and other sheltered places to recover their condition. The business of incubation is performed entirely by the females, which exhibit the greatest care in concealing their nests from other animals, several of which, and especially the crows, are exceedingly fond of sucking the eggs. For greater security, it is said that three or four females will sometimes lay their eggs in the same nest; and, in this case, one is always left to guard the precious deposit, whilst the others go to seek for food. The young can run as soon as hatched, but they are at first exceedingly susceptible of cold and wet, and it has been observed that in a rainy season the wild Turkeys are very scarce. The habits of the domestic birds are very similar. The wild Turkeys are taken either by shooting them at night when at roost upon the trees, or by enticing them into a sort of covered enclosure, called a *pen*, by strewing corn so as to lead the flock gradually up to the entrance. It is remarkable that although this fine bird, being exclusively an inhabitant of America, must have been very recently introduced into Europe, its origin was so soon lost sight of, that even Belon, Aldrovandus, and Gesner, supposed it to be a native of Africa and the East Indies; and our ordinary English name would seem to indicate, that at its introduction into this country it was considered to come from the east. A second species of Turkey is found in Honduras; it is a much more splendid bird than the common Turkey, its plumage being of a fine metallic green, passing to coppery, and each tail feather furnished with a blue eye-spot, surrounded by a black ring. It is called the Ocellated Turkey (*Meleagris ocellata*).

The Guinea Fowl, or Pintadoes (*Numida*), of which a few species are found in Africa, have the head and upper part of the neck naked, the top of the head being furnished either with a naked crest, or a tuft of feathers; at the base of the lower mandible there is a pair of small wattles, and the tarsi are usually destitute of spurs. The common Guinea Hen (*Numida meleagris*) is an inhabitant of the warmer parts of Africa, but is common in our poultry-yards; and in America, individuals that have escaped from captivity have multiplied to such an extent, that in Jamaica and some of the other West India Islands, their depredations upon the provision grounds render them a nuisance. The common Guinea Fowl is rather a large bird, exceeding the ordinary domestic cock in size; it is of a dark gray colour, covered with small, round, white spots. It is a restless, noisy bird, incessantly uttering a harsh cry, which has been compared to the syllables *ca-mac, ca-mac*, frequently repeated. This renders their proximity rather disagreeable; but, although their tenderness prevents their being propagated to the same extent as the ordinary domestic poultry, the delicacy of their flesh and eggs causes their presence to be tolerated. They were well known to the ancients, and formed a conspicuous part in the feasts of the Roman epicures.

In a wild state they live in flocks in woods, especially in the neighbourhood of marshy places, feeding on insects, worms, and seeds, for which they scratch in the ground in the manner of the common Fowl. They roost upon trees, and when pursued usually take refuge in the same situation. In Jamaica, where they often do great damage, they are taken by a curious stratagem. Some corn is steeped in rum mixed

with the intoxicating juice of the cassava, and then strewed upon the ground in the plantations exposed to their depredations; the birds, on paying their nocturnal visit to the spot, finding such an abundant supply of food within their reach, feed upon it greedily, and are soon found reeling about in a state of helpless intoxication. The nest is made upon the ground in a tuft of grass, or a thicket, and contains as many as twenty eggs.

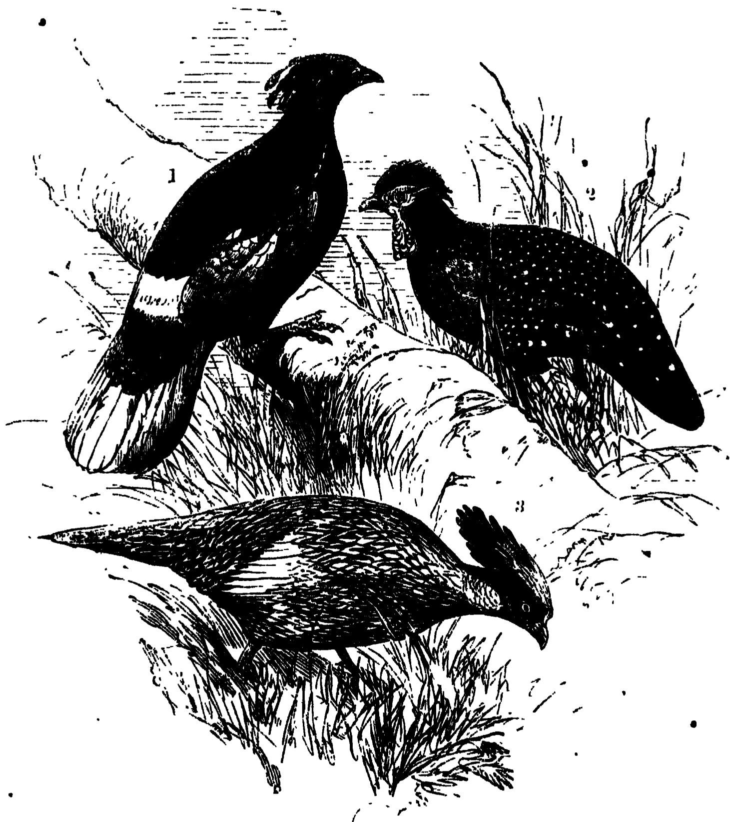



Fig. 178.—Group of Pheasants. 1, Impeyan Pheasant (*Lophophorus Impeyanus*); 2, Tragopan (*Ceriornis satyra*); 3, Pucras Pheasant (*Pucrasia macrolopha*).

In the sub-family of the *Phasianinæ*, or True Pheasants, the tail is more or less elongated, usually very long, wedge-shaped, pointed, and composed of narrow, wedge-shaped feathers. Of this group, which includes the Pheasants and Domestic Poultry, the best known *wild* species is the common Pheasant (*Phasianus colchicus*). This bird, which is too well known to need description, although naturalised in this country and included in our lists of birds, cannot be regarded as a native species, and except in

some very favourable situations, considerable care is necessary to prevent its extinction. It is a native of western Asia, and is supposed to have been originally introduced into Europe from the banks of the Phasis, a river of the ancient kingdom of Colchis, situated at the eastern extremity of the Black Sea, and from this locality its scientific name is derived. It is now, however, very generally distributed over the whole of the southern parts of Europe.

The description of the habits of the common Pheasant will serve with but little variation for the whole group. Its favourite haunts are woods and thickets, always in the neighbourhood of water, and it frequently takes to marshy islands, overgrown with rushes or osiers. In the summer the Pheasants roost on the ground, but during the latter part of the autumn and winter they pass the night upon the trees. They feed upon grain and seeds of various kinds, intermixed with fruits, green herbage, roots, and insects. Mr. Yarrell says, that he has seen them feeding upon blackberries, sloes and haws; and that sometimes their crops are distended with acorns of such large size that the birds must have had some trouble in getting them down. They are also said to be particularly fond of the root of the common buttercup (*Ranunculus bulbosus*). In their movements Pheasants closely resemble the common Fowl, walking and running in the same manner and with great swiftness—in fact, rarely taking wing unless pressed with immediate danger. They are polygamous, and the males and females only associate during the breeding season, which is in the spring. At this time the males, which have kept together during the winter, separate, each taking up a particular station, where he collects a number of females round him, by strutting about, clapping his wings, and crowing. The females deposit from ten to fourteen eggs amongst long grass or bushes, the nest consisting merely of a small hollow lined with dried leaves; they are then deserted by the male, and the whole labour of incubation and bringing up the young brood is left entirely to them.

The Pheasant breeds pretty readily in confinement, but under these circumstances the female is apt to be somewhat careless in hatching the eggs, which are therefore usually put under a common Hen, and the possessors of preserves even collect all the eggs that can be found, hatch them in this way under a Hen, and turn the young out into the covers when fledged. In captivity the Pheasant will breed with the common Fowl and Guinea Fowl, and even in the wild state hybrids of this bird with the Black Grouse have been met with. A variety, the Ring-necked Pheasant, distinguished by having a white ring round its neck, is also supposed by some to be a hybrid with the *Phasianus torquatus*, a native of China. The young birds are very subject to a disease called the *gapes*, which is caused by the presence in the windpipe of a parasitic worm belonging to the genus *Fasciola*, which, causing the trachea to inflame, often produces suffocation. Various remedies are employed against this disease,—in its earlier stages garlic, chives or young onions are said to have a beneficial effect; but when the disease has become serious, the best remedy is fumigation with tobacco, the birds being enclosed in a tight box, and smoked until they are nearly or completely stupefied. Pheasant shooting is a favourite amusement with sportsmen, and perhaps no other description of game is so subject to the depredations of poachers. The numbers of these birds sometimes killed at *battues* is enormous, but it must be confessed that this practice is not one of the most sportsmanlike.

Numerous species of Pheasants are found in the wooded regions of the Asiatic continent and islands. Amongst these, two of the most beautiful are the Gold and Silver Pheasants of China, which are not uncommon in aviaries. The former (*Phasi-*

*anus pictus*) is one of the most magnificent species, its plumage being variegated with brilliant scarlet, yellow, and blue, and the head ornamented with a large yellow crest, which can be elevated at pleasure. Cuvier supposes that this bird was the original of Pliny's description of the Phœnix. In the Silver Pheasant (*P. nycthemerus*) the general colour of the plumage is white, but each feather is adorned with fine black lines, and the whole lower surface of the body is black. One of the finest species is the Argus Pheasant (*Argus giganteus*, Fig. 179), which inhabits the larger islands of the Eastern Archipelago. The male measures between five and six feet from the tip of the bill to the extremity of the tail, the greater part of which is formed by the two central feathers. The general colour of the plumage is brown; but the most remarkable character of the bird consists in the enormous size of the secondary quill-feathers of the wings, which often exceed three feet in length, and from their being adorned with a series of ocellated spots along the whole length of each, give the bird a very elegant appearance when the wings are expanded. The forests of the Himalayas contain some elegant species of this sub-family, two of which are represented on a preceding page (Fig. 178). One of these, the Pucras Pheasant (*Pucrasia macrolopha*), is closely allied to the common species; but the other, the Tragopan (*Ceriornis satyra*), makes a nearer approach to the ordinary fowl. This bird is remarkable for the singularity of the appendages with which the head of the male is adorned; the sides of the head are naked, and behind each eye there is a long horn of a bluish colour, which is also the tint of the dilatable wattles which hang down from the chin. The plumage in the male is of a rich red colour, adorned with small white spots; but in the females it is brown. The latter are also destitute of the appendages of the head.

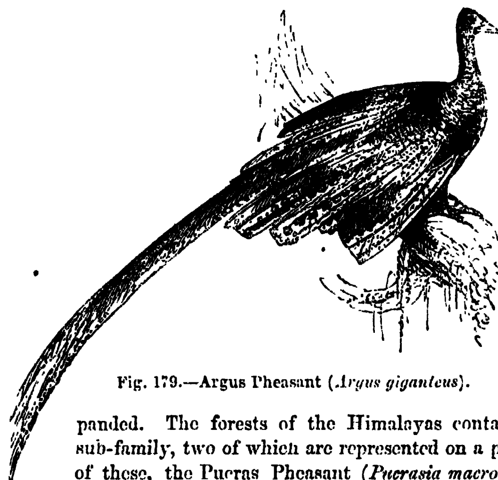


Fig. 179.—Argus Pheasant (*Argus giganteus*).

The most important species of this group, and perhaps the most valuable of all birds, is the Common Fowl (*Gallus domesticus*). This bird has been under the protection of man from time immemorial; and the earliest historical records which we possess, the curious paintings of the Egyptians, show that this and most of our ordinary domestic animals were as completely domesticated at that early period as in our own day. The original stock of the Domestic Fowl has been supposed to be the *Gallus Bankivus*, or Jungle Fowl of Java; but naturalists are far from having arrived at any certainty upon this point, and it seems not improbable, either that this valuable bird forms a species *per se*, or that it has been produced by an intermixture of nearly allied species.

Nearly allied to the true Pheasants are the *Lophophorinæ*, of which the Impeyan Pheasant (*Lophophorus Impeyanus*, Fig. 178) is a fine example. In these the bill is broad at the base and rather long, with the tip of the upper mandible projecting con-

siderably beyond that of the lower one, and the tail is broad and rounded at the extremity. The Impeyan Pheasant, which is the best known species, is found abundantly upon the Himalayas; the male is a handsome bird nearly as large as a Turkey, and of a general black colour; but the feathers reflect most beautiful metallic blue, green, golden, and coppery tints. The head is adorned with a remarkable tuft of plumes, which, like the feathers of the back, appear golden-green by reflection. The tail is of a fine chestnut-red colour, and the rump white. The females are far inferior in beauty to the males, being of a general brown tint, more or less variegated with gray and tawny. The bird feeds principally upon bulbous roots, for digging up which the elongated upper mandible is particularly adapted.

The last sub-family of the Phasianidous birds is that of the *Pavoninæ*, or Peafowl, distinguished by having a tuft or crest upon the head, and the tail-coverts greatly elongated, these being the feathers which in the common Peacock form that beautiful ornament usually known as the tail. The Common Peacock (*Pavo cristatus*) is undoubtedly one of the most magnificent of birds. Every one must have admired the splendid metallic colouring of the gorgeous train of this bird, with its hundreds of jewel-like eye-spots; and few objects in nature are more brilliant than a fine Peacock, with this beautiful appendage spread into a glittering circle in the bright rays of the sun. The form of the bird is also exceedingly elegant, and the general plumage of the body exhibits rich metallic tints, that of the neck particularly being of a fine deep blue, tinged with golden-green. The female, however, is of a much more sober hue, her whole plumage being usually of a brownish colour. The voice of the Peacock is by no means suitable to the beauty of its external appearance, consisting in a harsh disagreeable cry, not unlike the word *paon*, which is the French name for the bird.

Although naturalized as a domestic bird in Europe, the Peacock is a native of India, where it is still found abundantly in a wild state; and the wild specimens are said to be more brilliant than those bred in captivity. The date of its introduction into England is not known, but the first Peacocks appear to have been brought into Europe by Alexander the Great, although these birds were amongst the articles imported into Judea by the fleets of Solomon. They reached Rome towards the end of the Republic, and their costliness soon caused them to be regarded as one of the greatest luxuries of the table, although the moderns find them dry and leathery. This, perhaps, as much as the desire of ostentation, may have induced the extravagance of Vitellius and Heliogabalus, who introduced dishes composed only of the brains and tongues of Peacocks at their feasts. In Europe, during the middle ages, the Peacock was still a favourite article in the bill of fare of grand entertainments, at which it was served with the greatest pomp and magnificence; and during the period of chivalry it was usual for knights to make vows of enterprise on these occasions, "before the Peacock and the ladies." In the present day, however, the bird is kept entirely for the sake of the elegance of its appearance.

In a state of nature they frequent jungles and wooded localities, feeding upon grain, fruits, and insects. They are polygamous, and the females make their nests upon the ground, amongst bushes; the nest is composed of grass, and the number of eggs laid is said to be five or six. They roost in high trees, and even in captivity their inclination to get into an elevated position often manifests itself; and they may frequently be seen perched upon high walls, or upon the ridges of buildings.

The common Peacock and its immediate allies, have only a single spur on the tarsus; but the species of the genus *Polyplectron* are furnished with two, or even more,

of these weapons. In these birds the tail coverts are much shorter than in the True Peacocks, and in the best known species (*Polyplectron bicalcaratus*) are of a reddish colour, each adorned with a double ocellated, green spot.

We come now to a remarkable family of birds, inhabitants of the islands of the Eastern Archipelago and New Holland, in which the hatching of the eggs is generally left to the heat of the sun, assisted by the warmth evolved from a mass of vegetable matter collected by the parents, in which the eggs are imbedded. This is the family of the *Megapodiidæ*, in which the bill is rather stout, arched towards the apex, and obtuse at the tip; the wings are rounded, the tarsi long and stout, and usually covered with large scales, the feet large and the hind toe elongated and placed on the same level with the other toes. The claws are long and stout. These birds are divided into two sub-families, distinguished by the form of the bill.

In one, the *Megapodinæ*, or Mound birds, the bill is rather weak, and depressed towards the base, and stronger and slightly arched towards the apex. The species of this sub-family are found generally in the shady forests of the Indian islands. Their general habits are not very well known, but they are said to lay their eggs, which are of a large size, in holes in the sand, covering them over and leaving them to be hatched by the heat of the sun. Nevertheless, the habits of an Australian species, the Jungle Fowl (*Megapodius tumulus*) prove that these birds take more care of their offspring. This bird, which is about the size of the common Fowl, collects together vast heaps of vegetable matter in which to deposit its eggs, which are then hatched by the heat evolved during the gradual decay of the mass; the sun's rays evidently have little to do with the process, as the mounds are sometimes completely protected from them by foliage. One of these mounds has been seen measuring fifteen feet in height, and sixty in circumference at the bese. According to Mr. Gould, this bird is always found near the coast, where it keeps in dense thickets feeding upon seeds, berries, insects, and roots, the latter of which it scratches up with great facility with its powerful claws. Its flight is very heavy.

The *Leipoa ocellata*, or "Native Pheasant" of the Australian colonists, is another bird belonging to the present sub-family. It deposits its eggs in mounds formed of vegetable matter covered with sand, which are often as much as three feet in height, and nine in diameter. The eggs are much sought by the natives.

But the most remarkable of the mound-building birds is the Australian Brush-Turkey (*Talegalla Lathami*), which constitutes the type of the sub-family *Tallegallinæ*. This group differs from the preceding in the greater elevation of the base of the bill; but the habits of the birds are very similar. The Brush-Turkey, which is the species best known to naturalists, is about the size of a Turkey, and of a blackish-brown colour, with the head and neck nearly naked, furnished only with scattered, hair-like feathers. The colour of the skin in these parts is pink; but the neck is also furnished with a wattle of a bright yellow colour. This bird lives in small flocks in the bush, and generally eludes danger by the rapidity with which it runs through the tangled brushwood. When suddenly alarmed, however, the flock will immediately rise into the trees, where they perch upon the lowest branches, and then leap from branch to branch until they reach the top, when they often take wing, and fly to another part of the bush where they expect to be undisturbed. The quantity of decaying vegetable matter, collected by these birds for the reception of their eggs, is enormous, amounting, according to Mr. Gould, to from two to four cart-loads. Each of these mounds is produced by the united efforts of several pairs of birds, the females

of which lay their eggs in the mass at a considerable depth from the surface, and at a distance of about a foot from each other. The materials of the mound are entirely collected by means of the feet, the birds grasping a quantity of leaves or grass in one foot, and throwing it backwards towards a common centre, and in this manner, says Mr. Gould, they clear "the surface of the ground to a considerable distance so completely, that scarcely a leaf or blade of grass is left." A pair of Brush-Turkeys have lately bred in the Zoological Gardens, and it appears, from observations made there, that the male bird attends assiduously upon the mound, shifting the position of the eggs, and assisting the young on their first entrance into the world. The eggs, which are nearly four inches in length, are said to be delicious food, and are accordingly sought after with avidity both by the natives and colonists. A second species of Tallegalla (*T. Cuvieri*) is found in New Guinea, and a third species belonging to the group, the *Megacephalon malco*, inhabits Celebes, but their habits are almost unknown.

The last family in the order is that of the *Cracidæ*, or Curassows, which appear to be the American representatives of the Pheasants. They have the bill of moderate size, but more or less arched to the tip, with the nostrils situated at the base; the wings are short and rounded; the tail elongated and very broad; the tarsi and toes elongated, the former stout, the latter slender; and the hind toe is placed in the same plane with the others.

These birds are inhabitants of the forests of tropical America, where they feed upon seeds, fruits, buds, and insects. They live upon the ground, but roost and make their nests on trees. Some of them may be domesticated to a considerable extent; but others are very wild and untractable.

The common or crested Curassow (*Crax alector*, Fig. 180), is almost as large as a Turkey, or about three feet in length; it is of a shining black colour, glossed with purple and green, and the top of the head is furnished with a crest of curled or twisted feathers, which the bird can raise or depress at pleasure. The abdomen and tail coverts are white. The bill is strong, and much elevated at the base, where it is surrounded by a skin, in which the nostrils are pierced.

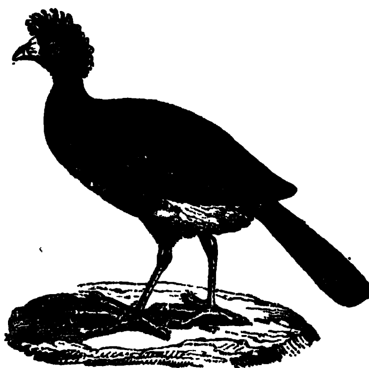


Fig. 180.—Curassow (*Crax alector*).

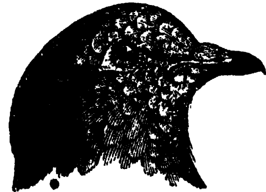
These birds are found abundantly in Brazil, and from that country to Mexico; they collect in small companies, and feed principally upon seeds and fruits. They are even domesticated in their native country; and a rather smaller species, the Red Curassow (*Crax rubra*), has even been brought into Holland, where it was found to be almost as prolific as the common Fowl. They associate readily with other poultry, and their flesh is said to be exceedingly delicate. A nearly allied species (*Crax globicera*), has a large, yellow, globular knob at the base of the bill. This is still more striking in the Pauxi (*Ourax pauxi*), which has an oval blue tubercle, of a stony hardness, and as large as the head, situated at the base of the bill. This bird is said to nidificate on the ground.

The Guans (*Penelope*) and their allies are also inhabitants of the great forests of tropical America. They are more elegant in their forms than the Curassows, and bear a considerable resemblance to the Pheasants. The throat has a naked skin, which the bird can dilate at pleasure. They live solitary, feeding principally upon fruits, and perching and making their nests on trees. Their flesh is said to be very delicate food; but the birds are timid and wild, and do not appear to submit to domestication so readily as the Curassows.

## Order V.—Columbæ.

**General Characters.**—With the order of the *Columbæ*, or Doves, we commence the second great section of the class of Birds, the *Insessores*, or pre-eminently perching birds, which, with comparatively few exceptions, pass the greater part of their time in the air, or perched in elevated situations, almost always selecting trees or rocks for the purpose of nidification, and devoting great care and attention to the bringing up of their young, until the latter are capable of flight.

The Doves are, in many respects, closely allied to the Gallinaceous birds, so nearly, indeed, that by some authors they are included in the same order, and it must be confessed that the two groups approximate very closely. The principal character by which the true Doves are distinguished from the Gallinaceous birds, is derived from the structure of the bill. The upper mandible is horny, and arched in its apical portion, but the base is occupied by a second convexity, formed by a cartilaginous plate which covers the nasal cavities, and in the anterior portion of which the nostrils are pierced; this, in its turn, is clothed with a skin which is smooth and scurfy in some species, whilst in others, and even in particular varieties, it acquires a fleshy development, and forms a warty lump at the base of the bill. The œsophagus speedily widens into a large crop, situated on both sides of the alimentary canal, and during the breeding season it is furnished with numerous glands for the secretion of a milky juice, which, mixing with the food in the crop, softens it so as to render it more fit for the nourishment of the young birds, which are fed for a considerable time with food regurgitated by their parents. The gizzard is very powerful, the intestine long and slender, and the cœca small.


Fig. 181.—Head of the Rock Dove (*Columba Livias*).

The tarsi are usually short, rather stout, and covered with scutella, but sometimes feathered. The toes are four in number, of moderate length, the hind toe being placed on the same plane as the anterior ones, which are not united by a membrane, even at the base, although in some cases the outer toe is completely united to the middle one at the base; the upper surface of all the toes is covered with short scutella, and beneath these the toes are considerably flattened and clothed with a papillate skin. The claws are rather short and curved.

The quill feathers of the wings and tail are very uniform in number. The former are generally long and pointed, and have ten primary quills: the tail is almost always composed of twelve feathers, rarely of sixteen. The general plumage is distinguished from that of the Gallinaceous birds by the absence of the plumules, or accessory feathers, which in the latter attain a great development.

The Columbæ, in general, are arboreal in their habits, but most of them seek their

food on the ground, and they all, notwithstanding the shortness of their legs, walk with ease and considerable celerity. Their flight, as might be expected from the form and size of their wings, is strong and sustained, and some species perform considerable migrations. In this respect they offer a striking contrast to the heavy, short-winged Gallinaceous birds, whose flight is usually slow, and only capable of being maintained for a short distance. In their mode of drinking, also, they differ remarkably from all other birds; for, instead of taking up a small quantity of water in the mouth, and then swallowing it by raising the head, they immerse the bill in the water, and drink without stopping until they are satisfied. The Pigeons generally nestle in trees or in the holes of rocks; rarely on the ground. The young, when hatched, are quite helpless, and require to be fed carefully by their parents for some time, during which they remain in the nest. The duty of incubation, and the care of the young, is shared by both parents.

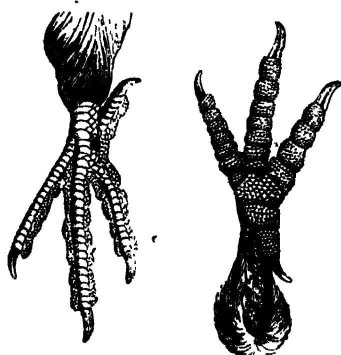


Fig. 182.—Foot of Ring Dove from above and beneath.

These birds are found in all the warm and temperate parts of the globe, but it is in the warmer regions that they occur in the greatest abundance. There, also, many of the species attain a splendour of plumage which rivals almost anything else that we meet with amongst the feathered inhabitants of the air, and of which our native species, although by no means deficient in beauty, can give us no idea. Everywhere the Doves are regarded with more or less favour, doubtless owing in a great measure to their reputation for conjugal fidelity and the peculiarly melancholy sound of their voice, which is universally a plaintive *cooing*. These characters, coupled with the continual exhibition of all the signs of a most tender affection between the sexes during the breeding season, induced the ancients to consecrate the Dove to Venus. In many Christian countries also the Dove is regarded as a sacred animal, because under its form the Holy Spirit is described as having descended upon our Saviour at his baptism.

**Divisions.**—These birds may be divided into five families. In the first, the *Didunculidæ*, the bill is about as long as the head, with the upper mandible much depressed at the base, strongly arched in its apical portion, and hooked and acute at the tip; the lower mandible has the apex truncated, and three distinct teeth on each side near the apex. The nostrils are placed in the middle of the membranous depressed portion of the base. The tarsi are stout; and the toes long, with long curved claws. This family includes only a single species, the *Didunculus strigirostris*, a bird a little larger than a Partridge, which inhabits the Navigator's Islands. This bird has the head and neck and the whole lower surface, with the exception of the under tail-coverts, black, glossed with green; the upper surface and the lower tail-coverts are chestnut-red, and the bill and a ring of naked skin round the eyes are yellow. From some notes on this bird, communicated to the Zoological Society by Lieut. Walpole, R.N., it appears that the *Didunculi* remain almost constantly upon trees, feeding upon berries and fruits during the day, and roosting at night amongst the branches.

They fly pretty well, and are generally seen either in pairs or small flocks. They nidificate amongst the rocks in the interior of the Islands, and the young, like those of other Pigeons, are naked and helpless. Their flesh is excellent. The natives, according to Lieut. Walpole, "are fond of keeping the *Didunculi* tame as pets, either taking them from the nest, or, when older, with bird-lime. They attach the bird by a long string fastened round one leg to a stick about two feet in length, with a fork at the end, which is stuck generally in the wall inside the hut, but sometimes in the ground outside. The natives, when they walk, often carry with them these sticks with the birds attached, and train the birds to leave the stick occasionally, and hover over it till it is again presented for the bird to perch on—the line by which it is attached being long enough to admit of this operation." The *Didunculus* is, however, particularly interesting from its constituting the nearest approach amongst existing birds to the singular extinct bird, the Dodo, the true position of which has been shown by MM. Strickland and Melville to be amongst the Columbæ.

This remarkable bird forms the type of the second family, that of the *Dididæ*. At the discovery of the Island of Mauritius in 1598, the Dodo was still abundant there, but in the course of a few years it was completely extirpated by the sailors. A few specimens were, however, brought to Europe in the period which intervened between its discovery and its final destruction, and from these several oil daintings were made, which, with two heads, a foot, and a few feathers, are now the only proofs of the existence of a large bird, which was certainly living within the last two hundred years. The Dodo (*Didus ineptus*, Fig. 183) is described as being considerably larger than a Swan, weighing sometimes fifty pounds, and of a very bulky and heavy form. The bill was long and strong, depressed at the base, with a separate and much arched apical portion, which was so sharp and strongly hooked at the tip, that the Dodo has been considered by some naturalists as approaching the predaceous birds. The nostrils were placed on the sides of the depressed portion of the bill, which was covered by a naked skin; the face was similarly clothed. The feet were very short and stout, but bear a considerable resemblance to those of a Pigeon. The wings were also very short, and quite incapable of raising the bird into the air even had they been furnished with the ordinary stiff quill feathers, but instead of these they bore a few soft decomposed plumes, like those of the Ostrich, and the tail was adorned with a tuft of similar but smaller feathers. This rudimentary condition of the wings led to the Dodo's being placed amongst the Cursorial birds by many writers. The general colour of the Dodo was a blackish-gray, but the plumes of the wings were of a light ash colour.

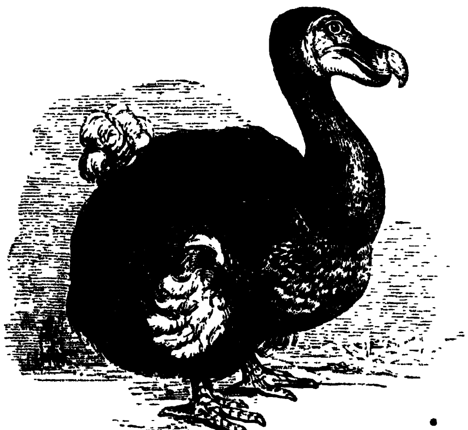


Fig. 183.—Dodo (*Didus ineptus*).

In the little Island of Rodriguez, lying in the ocean to the east of the Mauri-

tius and Bourbon, where the Dodo abounded, it appears from some bones in the possession of the Zoological Society that three species of wingless birds formerly existed. One of these Mr. Bartlett considers to be identical with the Dodo of the Mauritius, another was nearly twice the size of the Dodo, whilst the third was rather smaller than that bird. The latter is probably the *Solitaire*, which is described by Leguat, a French voyager, in the following terms:—

"Of all the birds in the island," says he, "the most remarkable is that which goes by the name of the *Solitary*, because it is very seldom seen in company, though there are abundance of them. The feathers of the male are of a brown-gray colour; the feet and beak are like a Turkey's, but a little more crooked. They have scarce any tail, but their hind part covered with feathers is roundish, like the crupper of a Horse; they are taller than the Turkeys. Their neck is straight, and a little longer in proportion than a Turkey's when it lifts up its head. Its eye is black and lively, and its head without comb or cap. They never fly, their wings are too little to support the weight of their bodies; they serve only to beat themselves and to flutter when they call one another. They will whirl about for twenty or thirty times together on the same side during the space of four or five minutes. The motion of their wings makes then a noise very like that of a rattle, and one may hear it two hundred paces off. The bone of their wings grows greater towards the extremity, and forms a little round mass under the feathers as big as a musket ball. That and its beak are the chief defence of this bird. 'T is very hard to catch it in the woods, but easie in open places, because we run faster than they, and sometimes we approach them without much trouble. From March to September they are extremely fat, and taste admirably well, especially while they are young. Some of the males weigh forty-five pounds.

"The females are wonderfully beautiful, some fair, some brown; I call them fair, because they are of the colour of fair hair. They have a sort of peak, like a widow's, upon their breasts (beaks?), which is of a dun colour. No one feather is straggling from the other all over their bodies, they being very careful to adjust themselves, and make them all even with their beaks. The feathers on their thighs are round like shells at the end, and being there very thick, have an agreeable effect. They have two risings on their *craws*, and the feathers are whiter there than the rest, which livelily represents the fine neck of a beautiful woman. They walk with so much stateliness and good grace, that one cannot help admiring and loving them; by which means their fine mien often saves their lives."

Making allowance for some poetic license, which the gallantry of the worthy Leguat appears to have induced him to take in his description of the females, this appears to be a trustworthy account of the aspect and manners of a bird nearly allied to the Dodo; and in this case, at any rate, Leguat is not deserving of the censure of Cuvier, who does not consider his testimony of any great value. At all events, some of the bones above referred to belonged to a bird about the size attributed by Leguat to the *Solitaire*, and recent authors have appropriated Gmelin's name of *Didus solitarius* to this bird. To the third species, Mr. Bartlett gives the name of *Didus Nazarenus*, which was employed by Gmelin, for a bird described by François Coache, many years ago, under the name of the Dodo, but to which he ascribes only three toes. The occurrence of at least three species of large wingless birds upon these islands, separated as they are by many miles of sea, is a most remarkable circumstance; and, as the birds could by no possibility pass from one island to the other, the only plausible supposition by which their presence can be accounted for is, that these islands at one

time formed part of a great continent, which is now submerged beneath the waves of the great Indian Ocean. As the birds were in existence at a comparatively recent period, some naturalists are not without expectations that the same, or allied, species may still be found in the neighbouring and almost unexplored island of Madagascar. It will be exceedingly interesting, if we should hereafter receive living specimens of birds, the very existence of which was regarded as apocryphal by many eminent naturalists.

The third family is that of the *Gouridæ*, or Ground Pigeons, in which the bill is of moderate size, slender, straight, and much arched at the apex; the tarsi long and stout; and the toes long, margined with a sort of membrane, and furnished with short curved claws. These birds approach more nearly than any of the other members of the order to the true Gallinaceous birds; their tarsi are longer, and they generally live in flocks upon the ground, where they seek their food, consisting of seeds, &c., and rarely perch upon trees. They are found in the warm parts of both hemispheres, and some of them attain a considerable size; the type of the family, the Crowned Pigeon of the Indian Archipelago (*Goura coronata*), being nearly as large as a Turkey. It is kept in the poultry yards in Java, but does not breed in Europe. Many of the species are exceedingly beautiful; one of them, the Nicobar Pigeon (*Calœnas nicobarica*), is remarkable not only in this respect, but also for the resemblance in the arrangement of the tail feathers to that of the cock. This bird is of a dark purplish, or nearly black, colour, with the feathers of the neck long, pointed, and glossed with blue, red, and gold; the wings are blue, the back brilliant golden-green, and the tail white. It is found in several parts of India.

From these we pass to the *Columbidæ*, or true Pigeons, the family to which all our British species belong. These birds present the characters of the order in their greatest perfection. The bill is rather slender, horny, arched, and acute at the tip, covered with a soft tumid skin at the base; the nostrils are pierced in the form of longitudinal slits in the front of the basal swelling (Fig. 181); tarsi are short, and usually about equal in length to the hinder toe; the anterior toes are elongated (Fig. 182). These birds generally live in wooded places, and roost in the trees. They feed, however, for the most part on the ground, picking up seeds of all kinds, young herbage, and roots. In the autumn some of them eat large fruits, such as beech-mast and acorns, which they are obliged to swallow whole, their bills not being strong enough to make any impression on them. Some of them make their nests amongst the branches of trees, others in hollow trees, or in holes of rocks; and it appears that in Norfolk the Stock-dove (*Columba œnas*) often lays its eggs in deserted rabbit-burrows, generally without any nest. This bird also nestles in thick furze-bushes upon the heaths in the same county, but in other localities it is said to live in woody places, and to build in trees like its congeners. The largest of the British species is the Ringdove, or Cushat (*Columba palumbus*), which is generally distributed in all the wooded parts of the country; the Stock-dove, on the contrary, is found only in the southern and midland counties of England, and these are also the parts most frequented by the Turtle-dove (*Columba turtur*), which, however, is only a summer visitor to this country. A fourth British species is the Rock-dove (*Columba livia*, Fig. 181), which is the original of most of our domestic varieties. In a state of nature, this bird, which is very generally distributed over the northern temperate portion of the eastern hemisphere, lives and breeds entirely in holes of rocks, and is to be found abundantly on all our rocky coasts. It feeds on grain, and is also found to eat considerable numbers of several species of

snails. It produces two broods in the year, each consisting of a pair of birds. Our space will, of course, preclude any description of the numerous varieties of this bird produced by domestication, some of which differ so widely from each other and from the original stock, that it is difficult to imagine that they all belong to the same species. The nearest approach to the wild species is made by the common House Pigeon, many specimens of which almost exactly resemble their original parents in form and colour; but the different kinds of fancy Pigeons, as they are called, exhibit most remarkable differences in both these particulars. Thus, in the Tumblers, which in their general form present the closest resemblance to the Common Pigeon, the head and bill are greatly reduced in size, and the birds have also acquired the curious habit of turning over suddenly in the air; in the Carriers the head and bill are much elongated, and the naked skin about the base of the bill and round the eyes is greatly developed, fleshy, and warty. The Pouters have an enormously inflated crop, which projects in front of the breast, causing the bird to throw its head back, and hold itself in a most unnaturally upright position; and the Jacobins have the feathers of the head and neck inverted in such a manner as to form a sort of ruff or hood. The most remarkable change, however, is perhaps that which has produced the variety of the Fantails, or Broad-tailed Shakers, in which the tail, which is beautifully expanded in an arched form, contains no less than thirty-six feathers, the normal number being only twelve

One of the most singular faculties possessed by these birds is that of finding their way to their ordinary residence when let loose at a great distance from home. This faculty is exhibited to a greater or less extent by all the varieties of pigeons, and even by domesticated individuals of the original stock; but it acquires its most remarkable development in the variety called the Carrier, from its having long been employed in conveying notes and messages in which speed and secrecy were required. The distance travelled by these birds, and the rapidity with which they fly, is perfectly astonishing. Mr. Yarrell mentions one case in which a Carrier Pigeon flew from Rouen to Ghent, a distance of one hundred and fifty miles in a straight line, in an hour and a half. In the East, which appears to be the original country of this variety, they were formerly employed as a regular *flying post*, the letters to be conveyed being fastened under one of the wings. They have also the reputation of being unconscious agents in carrying on many clandestine love affairs; but in the more civilized countries of Western Europe they have generally been employed for more disreputable purposes, by conveying important intelligence to Stock Exchange speculators, and bringing news of the results of races, &c., to sporting men, before these could possibly be known in the regular course of things, thus enabling them to operate with safety in their speculations and bets. The electric telegraph, however, must have nearly put a stop to their employment in this way.

There is one other species of this family to which we must refer, the Passenger Pigeon (*Ectopistes migratorius*) of North America. This bird is about the size of our common Pigeon, but the tail is greatly elongated and wedge-shaped, with the middle feathers blackish-brown, and the lateral ones white. It is very abundant in all parts of North America, and is remarkable from its migrating in immense flocks from one part of the United States to another. Audubon, who has given a most interesting account of these birds, noticed them passing one place almost continuously for three successive days. To give some idea of their numbers he makes the following calculation. He supposes a column of one mile in breadth to pass over a given spot for three hours at the rate of one mile per minute. This gives a parallelogram of one hundred and eighty

square miles, and allowing two pigeons to the square yard, the column would contain upwards of one billion, one hundred and fifteen millions of pigeons; and as every pigeon consumes at least half a pint of food daily, the daily consumption of such a flock would be no less than eight millions seven hundred and twelve thousand bushels.

This would appear to be by no means an exaggerated estimate, as the Pigeons are said completely to fill the air, eclipsing the light of the sun. The speed with which they travel is shown by the fact that Pigeons have been killed in the neighbourhood of New York with their crops still filled with rice, which could not have been obtained by them nearer than the fields of Carolina and Georgia, a distance of between 300 and 400 miles; and as it is known that these birds will entirely digest their food in the course of twelve hours, they must have passed over the intervening space in about six hours, or at the rate of about a mile in a minute. Their arrival at their roosting-places is anxiously watched for by the inhabitants of the neighbourhood, who destroy them in great numbers. Audubon gives the following animated description of one of these nocturnal *battues*:—"The sun," he says, "was lost to our view, yet not a Pigeon had arrived; but, suddenly, there burst forth a general cry of, '*Here they come!*' The noise which they made, though yet distant, reminded me of a hard gale at sea passing through the rigging of a close-reefed vessel. As the birds arrived and passed over me, I felt a current of air that surprised me. Thousands were soon knocked down by the men provided with poles. The current of birds, however, kept still increasing. The fires were lighted, and a most magnificent, as well as a wonderful and terrifying sight, presented itself. The Pigeons, coming in by thousands, alighted everywhere, one above another, until solid masses of them, resembling hanging swarms of bees, as large as hogsheads, were formed on every tree, in all directions. Here and there the perches gave way under the weight with a crash, and, falling to the ground, destroyed hundreds of birds beneath, forcing down the dense groups with which every stick was loaded. It was a scene of uproar and confusion. I found it quite useless to speak, or even to shout, to those persons nearest me. The reports even of the nearest guns were seldom heard, and I knew only of the firing by seeing the shooters reloading. No person dared venture within the line of devastation; the hogs had been penned up in due time, the picking up of the dead and wounded being left for the next morning's employment. Still the Pigeons were constantly coming, and it was past midnight before I perceived a decrease in the number of those that arrived. The uproar continued, however, the whole night; and, as I was anxious to know to what distance the sound reached, I sent off a man accustomed to perambulate the forest, who, returning two hours afterwards, informed me he had heard it distinctly when three miles from the spot." Towards daybreak, according to the same authority, the Pigeons again move off, and various nocturnal beasts of prey are seen sneaking away from the ground, where they have found a plentiful and accessible meal; the human devastators then go in to collect their share of the plunder, and when they have selected all that they have occasion for, the hogs are let loose to feed upon the remainder.

Two or three instances are on record of the occurrence of single specimens of the Passenger Pigeon in this country, and when we consider the great powers of flight possessed by the species, it is not impossible that they may have crossed the ocean, although some ornithologists are more inclined to believe that they must have escaped from aviaries. They make a slight nest of sticks and straws on the branches of trees, but unlike other Pigeons lay only one egg. A pair built and hatched their young in the gardens of the Zoological Society in 1832, when it was observed that the female

formed the nest, the male bringing the materials and always alighting on the back of his partner, so as to avoid the chance of disarranging the portion already put together. Both parents assisted in the business of incubation.

The last family of the Columbæ is that of the *Treronidæ*, or Tree Pigeons, in which the bill is short and stout, with both mandibles nearly equal in thickness and equally arched towards the tip, the tarsi are very short and usually more or less feathered, and the inner toes are much shorter than the outer. These birds are confined to the warmer parts of the old continent, their principal habitation being in India, the Islands of the Eastern Archipelago, and Australia. Their nourishment consists, for the most part, of fruits, and they are especially arboreal in their habits. In the form of the bill, however, they present some resemblance to the extinct Dodo. Many of them are most beautifully coloured, rivalling in this respect the Parrots and Pheasants.

## Order VI.—Scansores.

**General Characters.**—The principal character by which the Scansorial birds are distinguished from the Passeres, with which it must be confessed they are very closely allied, consists in the peculiar arrangement of the toes, of which two are always directed forwards and two backwards (Fig. 184). This disposition of the toes enables these birds to climb with great facility, some of them, as the Parrots, by grasping the smaller branches, and using the feet in the manner of hands, whilst others, such as the Woodpeckers and their allies, may rather be considered to run upon the surface of the trunks and larger branches in every direction. The feet are almost invariably clothed with shields, rarely reticulated, and the tarsi are never covered with a single, long, anterior plate.

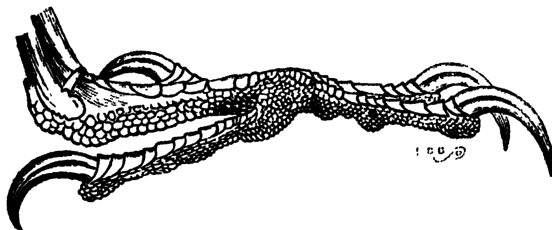


Fig. 184.—Foot of the Ivory-billed Woodpecker (*Picus principalis*).

In the form of the bill and the mode of life, there is but little agreement amongst these birds; the bill in some being short and strong, with the upper mandible much hooked, in others straight, with the extremity either pointed or truncated: the former live principally upon fruits and seeds, the latter upon insects. In most case, however, the wings are rather short, and the flight by no means vigorous.

**Divisions.**—This order includes four families,—the *Cuculidæ* or Cuckoos, the *Picidæ* or Woodpeckers, the *Psittacidæ* or Parrots, and the *Rhamphastidæ* or Toucans.

In the *Cuculidæ* the bill is usually slender and compressed, with the ridge of the upper mandible arched, and its margin notched near the tip; the nostrils are placed in a membranous groove, the tail long and rounded, and the toes long and unequal. These birds, which are very numerous, are generally distributed over the globe, but are most abundant in the tropics. They are divided into several sub-families, of the first of which our common Cuckoo (*Cuculus canorus*, Fig. 185) is the type. This is the sub-family of the *Cuculinæ*, or True Cuckoos, in which the bill is broad and rather depressed at the base, with the ridge of the upper mandible curved; the nostrils are membranous, the wings long and pointed, the tarsi short and partly clothed with feathers,

and the outer toe capable of being directed either forwards or backwards, at pleasure. The Cuculinæ are exclusively inhabitants of the Eastern Hemisphere, in the warmer parts of which they are tolerably abundant; but only occur as summer visitors in the colder regions.

The habits of the common Cuckoo may be taken as exemplifying those of the birds of this sub-family in general. This bird, which is about the size of a small pigeon, is of a general grey tint, with the breast barred with brownish black, and the tail feathers blackish; it arrives in this country in the month of April, and its peculiar song may be commonly heard from May to July, when it again departs for warmer regions. This song consists only of two notes, which bear a close resemblance to the word *Cuckoo*, repeated with a particular intonation. Notwithstanding this monotony, however, the note of the Cuckoo, from its being associated with the arriva of Spring, is generally heard with pleasure by most people, although in some places, under certain circumstances, it is regarded as an evil omen. Shakspere also attributes a meaning to the song of this bird which would certainly account for a very wide-spread unpopularity.

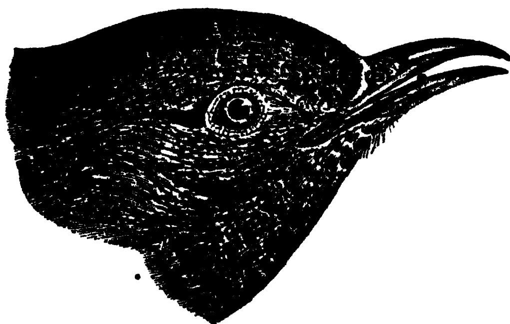


Fig. 185.—Head of the Cuckoo (*Cuculus canorus*).

The Cuckoo feeds almost entirely upon insects, and principally upon Caterpillars, amongst which it appears to prefer the large hairy Caterpillars of the Tiger Moth (*Arctia caja*), with the hairs of which its stomach is often completely lined. Intermixed with these are usually found the legs and other hard parts of Beetles, which also constitute a portion of its food; but none of these indigestible objects are said to pass into the intestine, so that the bird must evacuate them from the mouth, as many birds of prey are known to do with the bones and feathers of their victims. Its flight is tolerably swift and gliding, and when at rest, it generally perches on trees and bushes. It does, however, frequently visit the ground, for the purpose of searching for worms and caterpillars; but the shortness of its legs prevents it from walking with ease.

The most remarkable circumstance in the history of the Cuckoo is the singular manner in which it provides for its young, which, however, is also common to all the species of this group whose habits have been observed. Instead of building a nest for itself, the Cuckoo always deposits her eggs in the nests of some of the small insectivorous birds, generally placing only one egg in each nest. As the birds usually selected as foster-parents are all smaller than the Cuckoo, and frequently place their nests in very inaccessible situations, it has occasionally been a matter of speculation how the intruder could contrive to introduce her egg into the nest. A circumstance recorded by Mr. MacGillivray, on the authority of two young Scotch farmers, would seem to throw some light upon this subject. A Cuckoo descended upon a particular

spot, and after looking about, took up an egg in its bill, and hopped down with it amongst some heath. In this was a Titlark's nest with a small opening, from the side of which the Cuckoo was seen to rise by the observers, and on examination the nest was found to contain a newly dropped Cuckoo's egg, with one of the Titlark's.

The egg of the Cuckoo is comparatively of small size, so that the small birds into whose establishment the intruder is thus foisted, are not alarmed at its presence, but hatch it together with their own offspring, and when hatched, pay as much attention to the young parasite, as if his presence in the nest was perfectly legitimate. The young Cuckoo, however, repays all this care with a behaviour which looks very like gross ingratitude; for, as soon as he has acquired sufficient strength, he proceeds, in the most business-like manner, to get rid of his foster-brothers, in order to appropriate to the gratification of his own inordinate appetite the whole of the supplies brought by the parent birds. For this purpose he gently insinuates his rump under the body of one of the young birds, and by the assistance of his wings, continues to hoist the unfortunate little animal upon his back, which is furnished with a peculiar depression to enable the latter to rest comfortably in that dangerous position. Having succeeded thus far, the young Cuckoo proceeds backwards to the edge of the nest, and then, with a sudden jerk, throws off his burden. In this manner, in the course of a few days, the usurper remains in undisturbed possession of the nest, and secures to himself the entire attention of the birds which he has thus deprived of their legitimate offspring. This care is continued long after the young Cuckoo has left the nest, and it is even said that the cry of this bird will induce any of the small birds in its neighbourhood to come and feed it. In confinement young Thrushes, which could only just feed themselves, have been known to attend upon young Cuckoos, and one instance is on record in which the Cuckoo severely punished his voluntary nurse for what he considered a neglect of duty. The Thrush and the Cuckoo were kept in a large wicker cage, in which the latter occupied the upper perch, and made his companion hop down to fetch food for him. "One day," says the late Bishop of Norwich, "when it was thus expecting food, the Thrush, seeing a worm put into the cage, could not resist the temptation of eating it, upon which the Cuckoo immediately descended from its perch, and attacking the Thrush, literally tore one of its eyes quite out, and then hopped back; the poor Thrush felt itself obliged to take up some food in the lacerated state it was in. The eye healed in course of time, and the Thrush continued its occupation as before, till the Cuckoo was full grown." The common Cuckoo is a very widely distributed species. It is found during the summer in all parts of Europe, even as far north as Lapland, and is included in the lists of birds of the most northern parts of Asia. Southwards it extends over all the tropical parts of Asia, and to the southern extremity of Africa. Another species, the Great Spotted Cuckoo (*Coccystes Glandarius*), which is an inhabitant of the warmer parts of Africa, is frequently found in southern Europe, and a single specimen has found its way to Ireland.

In the second sub-family, that of the *Crotophaginæ*, or Anis, the bill is compressed, with the ridge of the upper mandible curved, and the nostrils placed at the base, and pierced in the substance of the bill; the wings are usually short and rounded, the tarsi long, and the two outer toes longer than the others. These birds are all inhabitants of the tropical regions, where they live in the forests, feeding principally upon insects and fruits. The typical genus, *Crotophaga*, is confined to South America; it has the bill much compressed, and the ridge of the upper mandible dilated into a keel. The *Crotophagæ*, or Anis, are usually about the size of a blackbird, or a little larger; they

are generally distributed in South America, where they live in bands, principally on the borders of woods, especially in swampy places. They feed upon insects and their larvæ, small reptiles, and some fruits and seeds. Several females are said to lay their eggs in a sort of common nest, where they hatch and bring up their young in company.

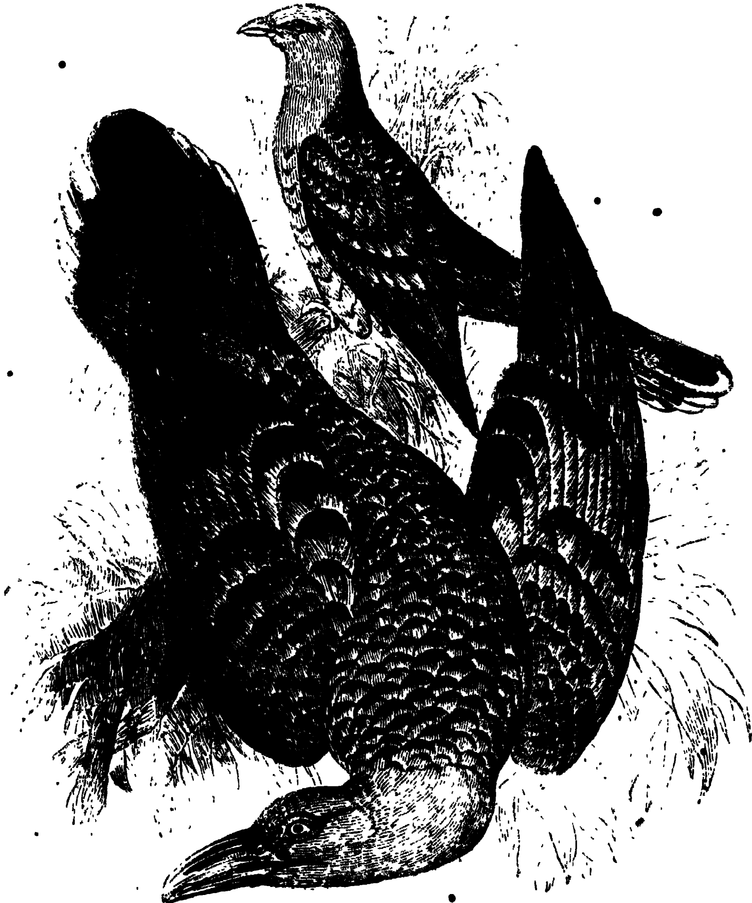


Fig. 186.—The Channel-bill (*Scythrops Novæ Hollandiæ*).

They are so bold, that when some members of their band have been shot, the rest of the troop will settle again at a very short distance.

The other birds of this group are all found in the Old World, and principally in India and the Islands of the Eastern Archipelago. A single species, the Channel-bill

*Scythrops Novæ Hollandiæ*, Fig. 186), is found in Australia, where it is a bird of passage. This bird is about the size of a crow, but has the tail so long that its total length is upwards of two feet. Its bill is very stout, and has two narrow channels close to the ridge of the upper mandible. According to Mr. Gould, it feeds principally on Phasmidæ and Coleoptera, but other observers ascribe to it frugivorous habits, and its diet probably consists both of fruits and insects. It is found not only in Australia, but also in many of the Eastern Islands, and its name in the Island of Celebes is said to indicate a belief on the part of the natives, that its appearance presages rain. Some of the other species are described as entirely frugivorous.

A third sub-family is that of the *Coccyzinæ*, in which the bill is more or less elevated at the base, with the ridge of the upper mandible arched, and the aperture of the nostrils linear, and partly closed by a scale; the wings are of moderate size, and more or less rounded; the tail elongated; the tarsi long, and covered with broad scales; and the toes and claws unequal in size.

These birds are also, for the most part, inhabitants of tropical regions; but, unlike the true Cuckoos, they occur in both hemispheres. They also want the parasitic habits of the true Cuckoos, building a nest and bringing up their young in the usual way; although, it is said, their eggs may occasionally be found in the nests of other birds.

The best known species is the *Coccyzus Americanus*, or American yellow-billed Cuckoo, which is also called the Cow-bird, by the inhabitants of the United States, from the resemblance of its note to the word *cow*, frequently repeated. This bird is found in all parts of the United States, and as far north as Canada, migrating from south to north in the months of April and May. It feeds principally upon Caterpillars, nd is said to be particularly partial to some which infest apple trees; it also eats berries of different kinds, and is charged with the crime of sucking the eggs of its neighbours.

The Yellow-billed Cuckoos pair early in May, when severe combats take place amongst the males. They build their nests upon the horizontal branches of trees, frequently selecting apple trees for this purpose; the nests are constructed with a few twigs and sticks, intermixed with green weeds, and are almost flat. They lay four or five eggs, upon which the female sits with great assiduity, almost allowing herself to be seized before she will quit the nest; and when compelled to do so, she falls to the ground and flutters along, feigning lameness in order to draw the intruder away from her treasures. Four specimens of this bird have occurred in Britain, and it appears so improbable that these could have migrated across the Atlantic, that some ornithologists have expressed a belief that the bird may yet be found in the north of Europe; there does not seem, however, to be any good foundation for this opinion.

Another species of this group is found in North America, but the remainder are confined to the tropics. Those of the genus *Centropus*, inhabiting Africa, India, and the eastern islands, are called Lark-heeled Cuckoos, from their having the claw of the hind toe much elongated, as in the Larks; they are also known as Pheasant-Cuckoos, from the great length of their tails. These birds, and many others belonging to the group, seek their food upon the ground, and some of them even devour small Reptiles.

The *Saurotherinæ*, or Ground Cuckoos, are very nearly allied to the preceding group; but are distinguished by the greater length and straightness of the bill, the upper mandible being curved only at the tip. They are all inhabitants of the tropical

parts of America, and live principally on the ground amongst bushes, feeding upon seeds, worms, and insects, especially caterpillars, and even frequently swallowing small snakes, lizards, frogs, young rats, and small birds. The best known species is the *Saurothera vetula*, an inhabitant of the West Indies, especially Jamaica and St. Domingo, which measures about fifteen inches in length.

The last sub-family of the Cuculidæ is that of the *Indicatorinæ* or Honey-guides, a group of small birds which inhabit the forests of Africa, India, and Borneo. In these birds the bill is short, broad at the base, and arched above, with the nostrils placed close to the ridge of the upper mandible; the wings are long and pointed, the tarsi very short, and the outer anterior toe is the longest. At the Cape of Good Hope, where they were first discovered, these birds received the name of Honey-guides, from their actions frequently indicating to the natives the places in which the wild bees had made their nests and stored their honey. By the older naturalists, from the time of Sparmann, it was said that the Indicators actually led the human honey-seekers to the nests of the Bees, by fluttering before them and constantly uttering a peculiar cry, and that the Hottentots, on obtaining possession of the honey, always left a portion for their feathered guides. It appears probable, however, that the birds in endeavouring to get at the sweet booty, betray their object by their cries, and that the natives are guided to the place by this means. Their skin is said to be so tough, that the Bees in vain endeavour to sting them when engaged in their work of pillage; although they sometimes succeed in destroying their enemy by attacking his eyes. The common Honey-guides of the Cape ((*Indicator major* and *minor*), construct a bottle-shaped nest, with filaments of bark woven together; the nest is pendent, with the narrow part, in which is the opening, downwards.

The second family of the Scansorial birds is that of the *Picidæ* or Woodpeckers. In these birds the bill is elongated and straight,—much compressed towards the tip, which is usually obtuse or truncated; and the sides are generally furnished with a more or less distinct ridge. The typical species forming the sub-family *Picinæ*, which are distinguished by the great prominence of the lateral ridges on the bill, are distributed in all parts of both hemispheres, but are more especially abundant in the warmer regions. They are the well-known Woodpeckers, of which four species are found in Britain. They live in woods and forests, and run with great activity upon the trunks and branches of trees, often ascending

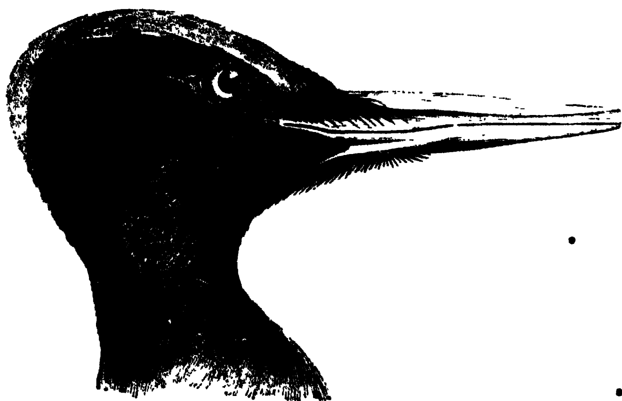


Fig. 137.—Head of the Great Black Woodpecker (*Picus martius*.)

the trunks in a spiral line, and continually tapping the surface with their bills. The object of this action is the discovery of soft rotten places, in which they may expect to find insects or larvæ; and when they hit upon a spot of this description, they immediately dig into it with great energy until they arrive at the concealed

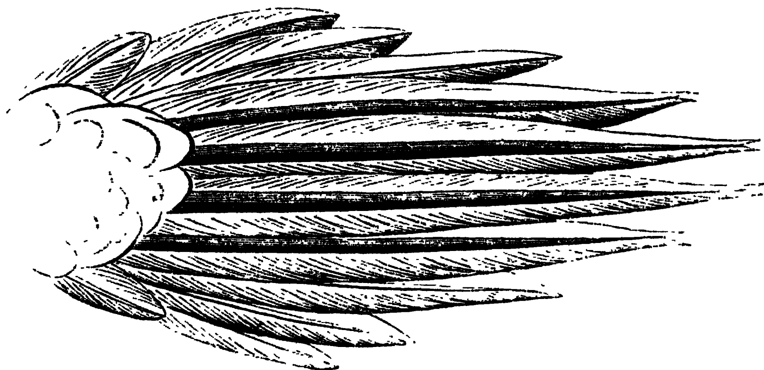


Fig. 188.—Tail of Picus robustus.

dainty. In running upon the trees, the Woodpeckers constantly make use of the stiff tail-feathers, to assist them in maintaining their position; and the feathers are pointed at the extremity, and usually more or less worn (Fig. 188).

Although these birds feed occasionally upon fruits and seeds, the greater part of their nourishment consists of insects and their larvæ, which they not only procure by digging into the decayed parts of trees, but also pick off the surface of the bark. To enable them to take up small insects, the tongue has undergone a very beautiful modification of structure. It is constantly covered with a mucous substance, secreted by very large glands, placed on each side of the throat, and is capable of being protruded to a considerable extent beyond the bill, when any small insect of course adheres to its glutinous covering, and is drawn into the mouth by the retraction of the tongue.

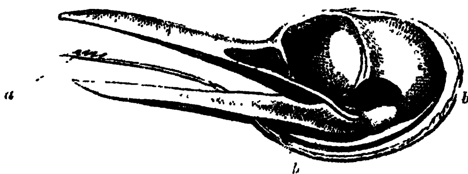



Fig. 189.—Head and tongue of Woodpecker. *a*, tongue; *b*, hyoid bone.

This power of extrusion and retraction is conferred upon the tongue by a peculiar arrangement of the hyoid bone, which is thus described by Mr. Yarrell. He says, "the great extensibility of the tongue is obtained by the elongation of the two posterior branches, or *cornua*, of the bone of the tongue, which, extending round the back of the head and over the top, have the ends of both inserted together into the cavity of the right nostril. These elongations, forming a bow, are each accompanied throughout their length by a slender slip of muscle, by the contraction of which the bow is

shortened, and the tongue pushed forward; another pair of muscles folded twice round the upper part of the trachea, and from hence passing forward, are attached to the anterior part of the tongue, and by their contraction bring the tongue back again." The gland secreting the glutinous matter communicates with the cavity of the mouth by a long duct, which opens at the point where the two bones of the lower mandible unite together, so that the tongue, when retracted, is necessarily indued with a fresh supply of this secretion. The tongue itself is horny at the tip, where it is also barbed with several small filaments directed backwards, the office of which is supposed to be the securing of larvæ, or insects, whose size would prevent their being captured by simple adhesion. Mr. Yarrell states that the Green Woodpecker (*Gecinus viridis*) feeds to a great extent upon ants, and that he has "seldom had an opportunity of examining a recently killed specimen, the beak of which did not indicate, by the earth adhering to the base, and to the feathers about the nostrils, that the bird had been at work at an ant-hill, and this species is therefore more frequently seen on the ground than any other of our Woodpeckers; it is also said to be a great enemy to bees."

One of our British species, the Great Spotted Woodpecker (*Dryobates major*), is said to have a peculiar habit, which would seem to evince a considerable amount of reflective power. This bird, according to one of the editors of Pennant's British Zoology, "by putting the point of its bill into a crack of the limb of a large tree, and making a quick tremulous motion with its head, occasions a sound as if the tree was splitting, which alarms the insects, and induces them to quit their recesses: this it repeats every minute or two for half an hour, and will then fly off to another tree, generally fixing itself near the top for the same purpose. The noise may be distinctly heard for half a mile."

The Woodpeckers roost at night in the holes of trees, and the females lay their eggs in similar situations, generally enlarging a natural hole with their bills for this purpose. When thus engaged, they are said to carry the chips to a distance, in order that their presence may not betray the proximity of the nest; but a portion of the chips remains in the bottom of the cavity, and upon these the eggs are deposited.

Mr. George R. Gray divides the true Woodpeckers into three sub-families, characterized principally by the position of the lateral ridge of the bill. Thus in the true *Picinæ*, this ridge rises from the middle of the base, bends down on each side towards the margin, and then rises a little to the apex; in the *Gecininæ*, of which our Green Woodpecker is an example, the ridge is placed close to the dorsal ridge of the bill; and in the *Melanerpinæ*, it is about half way between the dorsal ridge and the margin. The birds of the last-mentioned group are entirely confined to the Western Hemisphere, in all parts of which they are tolerably abundant. The typical species is the Red-headed Woodpecker (*Melanerpes erythrocephalus*), which is common in the United States, where it not only feeds like its European relatives upon the insects which it finds upon or under the bark of trees, but also commits considerable depredations in the orchards and corn-fields—to such an extent in fact, that, according to Kalm, a price was formerly set upon its head. From the statements of Wilson, the Red-headed Woodpecker would appear to be a great epicure in the matter of fruit, so constantly selecting the best, sweetest, and ripest apples for his own consumption that his presence upon an apple tree may always be taken as a proof that its fruit is the best in the orchard. "When alarmed," says Wilson, "he seizes a capital one by sticking his open bill deep into it, and bears it off to the woods."

Nearly allied to the *Picinæ* are the *Colaptinæ*, or Ground Woodpeckers, in which the bill is destitute of lateral ridges, or nearly so, and has the dorsal ridge curved to the tip, which is somewhat acute. These birds are found in both hemispheres, but are far less arboreal in their habits than the Common Woodpeckers, seeking for the greater part of their food upon the ground, in ants' nests and amongst the dung of animals. They are, however, by no means exclusively terrestrial, but are frequently seen seeking food upon trees; and, like the true Woodpeckers, they nidificate in hollows excavated by themselves in the trunks of trees. They also feed more or less upon fruits, and, like the Red-headed Woodpeckers, often attack the Indian corn-fields, when the grain is in its milky state.

The nearest approach to the Cuckoos is made by the Wrynecks, or *Yuncinæ*, in which the bill is short, straight, and pointed; the wings pointed; the tail rounded, and composed of soft feathers. This sub-family includes only a few species of birds, of which one, the Wryneck (*Yunx torquilla*, Fig. 190), is an inhabitant of, or rather a summer visitor to, the British Islands.

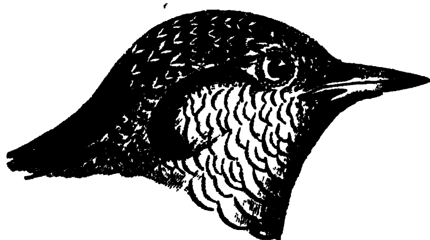


Fig. 190.—Head of the Wryneck (*Yunx torquilla*).

This bird, although its colours only consist of different shades of brown and gray, is generally regarded as one of the most beautiful of our native species, both on account of the elegance of its form and the delicacy of its markings. It arrives in this country in April, and quits us about the end of August or the beginning of September; so that both in its arrival and its departure it coincides pretty nearly with the Cuckoo, and hence in some parts of the country it is commonly known as the Cuckoo's Mate. The name of Wryneck is given to it from the singular habit of twisting its head about in various directions; and the same cause has given rise to the name of Snake-bird, which is applied to it in some localities.

As in the true Woodpeckers, the tongue is extensible, and the food consists principally of insects, which it frequently captures whilst running upon the trunks and branches of trees. It is, however, more commonly seen searching for food upon the ground, especially in the neighbourhood of ants' nests,—ants, with their larvæ and pupæ,* constituting a favourite article of consumption with this bird. Montagu describes it as an interesting spectacle to watch one of these birds, to which a portion of an ant-hill, with its inhabitants, had been given. The tongue was darted forward and retracted with extraordinary rapidity, and with such unerring aim that it never returned without an ant or a pupa adhering to it; and he describes the motion of the tongue as so rapid "that an ant's egg (pupa), which is of a light colour, and more conspicuous than the tongue, has somewhat the appearance of moving towards the mouth by attraction, as a needle flies to a magnet." The Wryneck is also said to eat elder-berries.

Like the Woodpeckers, this bird lays its eggs in a hole of a tree, which it adapts to its purpose by chiselling off pieces with its bill; the eggs, which vary from six to ten, are deposited upon the chips and rotten wood at the bottom of the cavity.

The two remaining sub-families of the Picidæ are entirely confined to the tropics.

The *Picumninæ*, or Piculets have a short, straight, compressed bill, rather acute at the tip, rounded wings, and a short tail, with the feathers broad, and rounded at the extremity. They are small birds, which closely resemble the Woodpeckers in their habits, except that they never appear to use their tails as a point of support. They inhabit the forests of the warm parts of both continents,—South America, India, and the Islands of the Eastern Archipelago. Like the Woodpeckers, they nidificate in holes of the trunks of trees, which they enlarge with their bills; they are said only to lay two eggs.

The last sub-family is that of the *Capitoninæ*, or Barbets, in which the bill is stout and conical, more or less inflated at the sides, and furnished at the base with numerous stiff bristles projecting forwards. Their wings and tail are short; the latter is usually even at the end, where its feathers are broad and rounded. These birds, which are united by many authors with the *Bucconinæ*, are all inhabitants of the tropics, where they feed upon insects and fruits. The species of the typical genus *Capito*, are confined to South America; the remainder are found in the Eastern Hemisphere. They are said to be dull and solitary birds.

We come now to a highly interesting group of birds—the family of the *Psittacidæ*, or Parrots, the members of which, in intelligence and beauty certainly equal, and perhaps surpass, all other birds. These birds are characterized by a large, strong bill, of which the upper mandible is considerably longer than the lower, and greatly curved, forming an acute point, overhanging the extremity of the lower mandible. The lateral margins of the upper mandible are frequently notched or toothed, and its base is clothed with a cere, in which the nostrils are pierced. The tongue, unlike that of the generality of birds, is soft and fleshy; the wings and tail are generally long, the latter especially being often of great length; the tarsi are short and stout, and the feet especially adapted for grasping.



Fig. 191.—Head of a Cockatoo.

The general appearance of these birds is well known. They are, for the most part, inhabitants of the forests of the warmest regions of the globe, where they live upon the trees, climbing amongst the branches, and feeding principally upon fruits; some species, however, are found on the ground. They form several sub-families.

Of these, one, the *Strigopinæ*, includes only a single species, the *Strigops habroptilus*, of New Zealand, where it is called the *Kakapo* by the natives. At first sight this bird appears to be intermediate between the Parrots and the Owls, and, like the latter, it is strictly nocturnal in its habits, passing the day in holes under the roots of trees, and in similar places. Its wings are very short, and its powers of flight very limited; it lives principally on the ground, and, according to the statements of Mr. Lyall (Proc. Zool. Soc.), forms tracks of about a foot wide, which so closely resemble footpaths made by men, that when first seen, they gave rise to an expectation that natives were in the neighbourhood. Its food, according to the same authority, consists partly of

roots, the beak being usually covered with dirt and mud, and partly of the leaves and tender shoots of plants.

The Kakapo breeds, in February, laying its eggs in the holes which it ordinarily frequents, without any nest except the rotten wood which already exists there. The



Fig. 192.—Group of Australian Parrots.

1. The Great Sulphur-crested Cockatoo (*Cocatua galerita*).—2. The Galeated Cockatoo (*Callocephalon galeatum*).—3. Barraband's Parakeet (*Palæornis Barrabandi*).—4. Ground Parakeet (*Pezoporus formosus*).

eggs are usually two in number, very rarely three. The cry of the Kakapo is a hoarse croak; and the natives say that, during the winter, great numbers of these birds assemble together in large caves; and that on their collecting, and again on dispersing for the summer, they make a perfectly deafening noise.

A second sub-family is that of the Cockatoos (*Cacatuinæ*), in which the tail is broad and even, and the head adorned with a crest which is capable of being elevated

and depressed at pleasure. These fine birds (Fig. 192, 1, 2) are confined to the Eastern Archipelago and Australia; but in the latter country they occur in great abundance. They feed principally upon fruits and seeds, and often commit great depredations, sometimes destroying considerably more than they consume. They also eat insects and larvæ. They make their nests in holes of trees, which they adapt to



Fig. 193.—Banksian Cockatoo (*Calyptorhynchus Banksii*).

their purpose by working at them with their powerful bills. When taken young they are very docile, and some of them will learn to speak very distinctly; although, as a general rule, their accomplishments in this respect extend no further than to repeating their own name, their ordinary voice being nothing but an abominable scream.

The best known species are white with yellow crests, and of these two or three are commonly brought to this country. The commonest are the Great and Small Sulphur-crested Cockatoos (*Cacatua galerita* and *sulphurea*); the former (Fig. 192, 1) a native of Australia, and the latter of the Moluccas. Amongst the finest birds of this group are the species of the genus *Calyptorhynchus* (Fig. 193), of which several species occur abundantly in Australia. The general colours of these large birds are black or brown, variegated with red or orange spots; and these colours form broad bands upon the quill-feathers of the tail.

The natives of those parts of Australia which abound in Cockatoos take a singular method of killing these birds, of which an interesting account is given by Capt. Grey in his "Travels in Australia." He says:—"Perhaps as fine a sight as can be seen in the whole circle of native sports is the killing Cockatoos with the kiley, or boomerang. A native perceives a large flight of Cockatoos in a forest which encircles a lagoon; the expanse of water affords an open clear space above it, unencumbered with trees, but which raise their gigantic forms all around, more vigorous in their growth from the damp soil in which they flourish. In their leafy summits sit a countless number of Cockatoos, screaming and flying from tree to tree, as they make their arrangements for a night's sound sleep. The native throws aside his cloak, so that he may not have even this slight covering to impede his motions, draws his kiley from his belt, and, with a noiseless, elastic step, approaches the lagoon, creeping from tree to tree and from bush to bush, and disturbing the birds as little as possible. Their sentinels, however, take the alarm, the Cockatoos farthest from the water fly to the trees near its edge, and thus they keep concentrating their force as the native advances: they are aware that danger is at hand, but are ignorant of its nature. At length the pursuer almost reaches the edge of the water, and the scared Cockatoos, with wild cries, spring into the air; at the same instant the native raises his right hand high over his shoulder, and, bounding forward with his utmost speed, to give impetus to his blow, the kiley quits his hand as if it would strike the water; but when it has almost touched the unruffled surface of the lake, it spins upwards with inconceivable velocity, and with the strangest contortions. In vain the terrified Cockatoos strive to avoid it; it sweeps wildly and uncertainly through the air,—and so eccentric are its motions, that it requires but a slight stretch of the imagination to fancy it endowed with life,—and with fell swoops in rapid pursuit of the devoted birds, some of whom are almost certain to be brought screaming to the earth. But the wily savage has not yet done with them. He avails himself of the extraordinary attachment which these birds have for one another, and fastening a wounded one to a tree, so that its cries may induce its companions to return, he watches his opportunity, by throwing his kiley or spear, to add another bird or two to the booty he has already obtained."

In the sub-family of the true Parrots (*Psittacinæ*), the tail is also short and square; but the head is destitute of a crest, and the lateral margins of the bill are toothed or crenated. The birds of this group are amongst the best known of the family of Parrots, as to it belong the gray and green species so commonly brought to Europe as pets. Many of them are exceedingly beautiful birds, and they are the most docile of Parrots; their conversational powers are also great, the gray Parrot (*Psittacus erythacus*) especially, learning to repeat many words, and even phrases, with great facility. This power of pronouncing words distinctly, which the Parrots possess in a far greater degree than any other birds, has rendered them great favourites in all ages, and numerous stories are related of absurdly apposite speeches made by

these birds. Indeed, it would very often appear that the birds had some notion of the meaning of the phrases they pick up, and this in some places seems to have given rise to a popular opinion that a well-trained parrot is capable of giving an account of its thoughts and observations. Most of our readers will probably remember a story related in the Arabian Nights of a jealous husband who purchased a parrot as a spy upon the actions of his wife, with the course adopted by the lady to get rid of such an unpleasant inmate; and although this may be rather too much for our belief, there can be no doubt that these birds, by blurting out expressions which they have heard, in the presence of those for whose ears they were never intended, may have given rise to *éclaircissements* of an equally disagreeable nature.

Some of the more genuine anecdotes of the speeches of these birds are, however, sufficiently ludicrous. One of the best is that related by Gesner, concerning a Gray Parrot belonging to King Henry VIII. This bird, which was kept in the King's Palace at Westminster, "by the river Thames, had picked up many words from hearing the passengers talk as they happened to take water. One day, sporting on its perch, the poor bird fell into the river; and then very seasonably remembering the words it had often heard some, whether in danger or in jest, use, cried out amain, 'a boat! a boat! twenty pound for a boat!' A waterman who happened to be near, hearing the cry, made to the place where the Parrot was floating, and knowing to whom it belonged, restored it to its royal master, in the full expectation, as the bird was a great favourite, of receiving the promised reward. The King, however, preferred appealing to the Parrot himself to determine the sum, which being consented to by the waterman, the bird immediately cried out, 'Give the knave a groat!'" Of a somewhat similar nature, but perhaps rather more probable, is the old story of the two Parrots belonging to a serious old lady, one of which (a recent acquisition) having bestowed some hearty forecastle curses upon his mistress, the other, whose education had been better attended to, immediately followed with the pious response, "We beseech thee to hear us, Good Lord."

The Psittacinæ are found abundantly in the luxuriant forests of the tropics, where they climb about upon the branches, with the help of their bill and feet, and feed principally upon fruits and seeds. The well-known Gray Parrot, already referred to, which was probably the first to be imported into Europe, is a native of the hottest parts of Africa. It is said to live as long as an hundred years, and there are instances on record of individuals attaining the patriarchal age of seventy. The commonest of the Green Parrots is the Amazonian Parrot (*Psittacus amazonicus*), which is rather larger than the gray species, of a shining green colour, with a blue band across the forehead; the cheeks, throat, and part of the wings, yellow or red. It is, as its name implies, an inhabitant of the banks of the great South American river Amazon; but it is also found in various parts of South America, and is said to do considerable damage in plantations.

The Lories (*Lorinæ*), have a rather large, but slender, bill, which is sometimes sinuated or slightly notched at the margin: the wings are rather short, and the tail is short, more or less graduated, and either pointed or rounded. These birds, which, although most of them are of small size, are amongst the most brilliant of the Parrots, are inhabitants of the Eastern Archipelago, New Guinea, Borneo, and the South Sea Islands. Many of them exhibit a peculiar structure of the tongue, that organ being furnished with a tuft of bristles, which is said to be employed by the bird in sucking the sweet juices of flowers, upon which, and berries, the Lories subsist.

The sub-family *Arainæ*, includes the gorgeous Maccaws of South America, with some other species inhabiting the western continent. In these birds the bill is of great size and strength, with the upper mandible much arched from the base, almost in a semicircle, and forming a long point which hangs down in front of the lower jaw; the lower mandible is short and very deep. The cheeks are frequently naked, and the tail very long and graduated.



Fig. 194.—Maccaw (*Ara*).

The true Maccaws, forming the genus *Macrocercus* or *Ara*, are pre-eminent both in size and magnificence of plumage, even amongst the beautiful family of Parrots They are confined to the hottest regions of America, Brazil, Guiana, and the West India Islands, where they inhabit the borders of the forests, keeping almost entirely upon the trees, and rarely visiting the ground. Their food is entirely of a vegetable nature, consisting of fruits and seeds, and the hardest rind is insufficient to preserve the kernel from the attacks of their tremendously powerful bills. They are distinguished by having the cheeks completely denuded of feathers, or furnished only with a few lines of minute plumes. The name *Ara*, applied to the genus by Kuhl, is derived from one of the Indian names of the birds, which is an imitation of their ordinary note. They lay their eggs in the hollows of trees; the eggs are two in number, and they are said to breed twice in the year. Both sexes take part in the duties of incubation.

One of the finest species is the Scarlet, or Red and Blue Maccaw (*Macrocercus macao*), which sometimes measures as much as three feet from the bill to the extremity of the tail. The greater part of the body is of a fine bright red colour; the rump, vent, and tail-coverts blue; the quill feathers of the wings are of a fine blue, and the wing-coverts greenish-blue and yellow. The tail, which when in fine condition, constitutes about two-thirds of the total length, is variegated with deep blue and crimson. The upper mandible is whitish, the lower one blackish or dusky, and the skin of the cheeks is white and wrinkled. This magnificent bird was formerly common in the West Indian Islands, but it has now become exceedingly rare in those localities. It is, however, still found on the continent of America, and specimens are frequently brought to Europe.

The Blue and Yellow Maccaw (*Macrocercus Ararauna*) is another beautiful species, rather smaller than the preceding, as it measures only about two feet and a-half in length. The whole of the upper part of this bird is of a fine blue colour, more or less tinted with green, whilst its lower surface—from the breast downwards—is of a light orange-yellow. The bill is black, and the throat is marked with a large black spot, which runs under the greater part of the bare white skin of the cheeks. This bird is

exceedingly abundant in the forests of tropical America, and great numbers of them are imported into Europe. They are easily reconciled to captivity, and have even been known to breed in France.

A small species, the Green Maccaw or Maracana (*Macrocercus severus*), which is about the size of a Pigeon, is exceedingly abundant in Brazil and Guiana, where it is said to visit the coffee plantations in immense flocks, which commit terrible depredations by devouring the berries.

Some of the other species of this group have the head entirely covered with feathers, except a small circle round the eyes. These form the genus *Psittacara*, so called from their apparently uniting the true Parrots or *Psittaci*, with the Maccaws or *Aras*. They are smaller than the Maccaws, but their plumage is generally exceedingly beautiful, and they learn to speak with greater ease. Le Vaillant states that he saw a specimen of the *Psittacara guianensis* or Guiana Parroquet, which could say the Lord's Prayer in Dutch, and whilst engaged in this exercise would lie upon its back and fold its feet together in the attitude of prayer. In Guiana, this species is said to be very destructive in the coffee plantations.

Nearly allied to this is the *Conurus carolinensis*, or Carolina Parroquet, the only species of this group that occurs in North America. It is found in the United States as far north as Lake Michigan (lat. 42° N.), but on the east coast does not extend beyond Maryland. It is singular that a bird belonging to a group which appears to be otherwise so exclusively confined to the hottest regions of the tropics, should be found at such a distance from the natural home of its race; but although the range of this species extends from the hot countries of Mexico to the very temperate region above mentioned, it does not appear to be a bird of passage, and indeed, Wilson says that he has himself seen these Parrots on the banks of the Ohio in February, flying about like pigeons in the midst of a snow-storm. The cause to which Wilson ascribes the occurrence of the Carolina Parrot at a higher latitude in the centre of the continent than on the coast is not the prevalence of a milder climate in those parts, so much as the existence of "certain peculiar features of country to which these birds are particularly and strongly attached; these are low, rich, alluvial bottoms along the borders of creeks, covered with a gigantic growth of sycamore trees or button wood—deep and almost impenetrable swamps, where the vast and towering cypresses lift their still more majestic heads—and those singular salines, or, as they are usually called, *licks*, so regularly inter-spersed over that country, and which are regularly and eagerly visited by the Parroquets." Their occurrence also appears to depend even still more upon the presence of their favourite articles of food, namely, the seeds of a plant called the cockle-burr, with those of the cypress and hackberry, and beech nuts. These fruits are by no means common in Pennsylvania and the States further to the north along the coast, but they are abundant in the whole of the country already referred to as inhabited by the Parrots.

These birds are exceedingly sociable in their habits, always flying in large flocks, and roosting in companies of thirty or forty together in the inside of a hollow tree. They are greatly attached to each other, nestling close together, and scratching one another's heads in a most affectionate manner. They manifest this attachment in an equally striking manner when any of their companions fall into misfortune. In illustration of this we may quote the following passage from Wilson's "American Ornithology." "At Big Bone Lick, thirty miles above the mouth of Kentucky River," he says, "I saw them in great numbers. They came screaming through the woods in the

morning, about an hour after sunrise, to drink the salt water, of which they, as well as the Pigeons, are remarkably fond. When they alighted on the ground, it appeared at a distance as if covered with a carpet of the richest green, orange, and yellow; they afterwards settled, in one body, on a neighbouring tree, which stood detached from any other, covering almost every twig of it, and the sun, shining strongly on their gay and glossy plumage, produced a very beautiful and splendid appearance. Here I had an opportunity of observing some very particular traits of their character; having shot down a number, some of which were only wounded, the whole flock swept repeatedly around their prostrate companions, and again settled on a low tree, within twenty yards of the spot where I stood. At each successive discharge, though showers of them fell, yet the affection of the survivors seemed rather to increase; for after a few circuits around the place, they again alighted near me, looking down on their slaughtered companions with such manifest symptoms of sympathy and concern, as entirely disarmed me." In captivity the Carolina Parrot is docile and sociable, and soon becomes very familiar. Like the other members of the group, it deposits its eggs in hollow trees, but is said to carry its sociable habits even into the business of incubation, several couples usually breeding in the same cavity.

The last sub-family is that of the Parakeets or Parroquets (*Pezoporinæ*), which are as completely confined to the Eastern Hemisphere, as the Arainæ to America. They resemble the smaller species of the preceding group in their general form, but the beak is much smaller, and the upper mandible is far less hooked. The tail is very long and graduated. These beautiful little birds, of which there are numerous species, occur principally in the sunny islands of the Eastern Archipelago; a good many are also found in Australia, and a few in India. The last mentioned country is the habitation of one of the most lovely of the species, the Rose-ringed Parakeet (*Palæornis torquatus*) which also appears to occur on the continent of Africa. This charming little bird is about fifteen inches in total length, but of this the tail takes up about two-thirds. Its general colour is a beautiful grass green, but round the neck is a rose-coloured band, from which the name of the species is derived. It appears probable from the scattered notices contained in the works of the poets and writers of antiquity, that this bird was the first species of Parrot known to the ancients, and Alexander was said to have brought a Parakeet, which must be either this or a closely allied species, the Alexandrine Parakeet (*P. Alexandri*), to Europe on his return from India. Both these species are exceedingly graceful and docile, and may be taught to speak with great facility.

These species of *Palæornis* are tolerably abundant in India, associating in large flocks, and doing considerable damage to the crops of fruit and grain. Lieutenant Burgess, in a recent communication to the Zoological Society, says, that as the grain crops ripen, they frequent the trees in the neighbourhood, whence they make descents on the fields, retiring again to the trees with the heads of the grain plants, which they then eat at their leisure. They breed in holes of trees and buildings, and lay three or four eggs.

A considerable number of the birds of this sub-family have the tarsi elongated, to adapt them for running with ease upon the ground. The most thorougly terrestrial species appears to be the *Pezoporus formosus*, or Ground Parakeet (Fig. 192, 4), of New Holland, a beautiful little bird, which measures about a foot in length, including the tail, which is regularly banded with green and black; the general plumage is also variegated with the same colours, each feather having a blackish-brown band. This bird lives entirely upon the ground; and Mr. Gould states that he never saw it perching, nor

was he ever able to drive it to take shelter in a tree. He gives the following account of its habits:—"It usually frequents either sandy sterile districts, covered with tufts of rank grass and herbage, or low swampy flats abounding with rushes and the other kinds of vegetation peculiar to such situations. It is generally observed either singly or in pairs; but, from its very recluse habits and great powers of running, it is seldom or ever seen until it is flushed, and then only for a short time, as it soon pitches again, and runs off to a place of seclusion, often under the covert of the grass-tree (*Xanthorrhæa*), which abounds in the district it frequents." Its eggs are laid on the ground.

The beautiful little Grass Parakeets, also inhabitants of Australia, are to a considerable extent terrestrial in their habits; but less so than the bird just referred. One of the most charming of these, and indeed of all the Parrots, is the diminutive Warbling Grass Parakeet (*Melopsittacus undulatus*), which is found abundantly over the vast central plains of Australia, but is scarcely ever seen in the districts between the mountain chains of that singular country and the coast. They feed in large flocks upon the seeds of the grasses which abound in the plains, but rest during the heat of the day upon the branches of the gum trees (*Eucalypti*), in the hollows of which they also lay their eggs and bring up their young. Upon these trees they also collect in crowds before starting in search of water. In captivity these diminutive creatures are amongst the most pleasing of the Parrots, for they are not only elegant in their forms and lively in their movements, but, instead of the horrible screeching noise which renders so many of their larger and more brilliant brethren exceedingly disagreeable neighbours, they have a soft warbling note, which is very pleasant. Several other species of Grass Parakeets, belonging to the genus *Euphema*, are also found in Australia, and they are all exceedingly elegant little creatures.

From the Parrots we pass to the family of the *Rhamphastidæ*, or Toucans, so remarkable for the disproportionate size of the bill (Fig. 103) in most of the species; and with these the order of Scansorial birds concludes. The bill in the Toucans is always of large size, sometimes almost as large as the bird itself; hence the name of *tout-bec* is frequently applied to the birds of this family by the French colonists in Guiana. Notwithstanding this enormous size, the bill is very light, the greater part of its bulk being made up of numerous air-cells, so that the bird can hop about with greater activity than would be expected from the cumbersome appearance of this appendage. The lateral margins of the bill are always serrated, and the tongue consists of a long slender stalk, furnished on each side with a series of filaments or barbs.

These remarkable birds are confined to the hot regions of South America, where they are very abundant. They live in considerable flocks in the forests, and sit in company on the trees, making an abominably harsh noise. They are omnivorous, feeding not only upon sweet pulpy fruits, which have generally been considered to constitute their whole nourishment, but also upon animal matters of various kinds, such as fish, eggs, small birds and Reptiles, and the larvæ of insects. In confinement, they take these articles of food without hesitation, and Voigt mentions that he saw one of them in England, which appeared to feel great satisfaction in destroying and devouring a Goldfinch. They are said usually to take their food up in the bill, and throwing it into the air, catch it again with open mouth and swallow it directly, neither the bill nor the tongue being adapted for the purposes of deglutition in the ordinary way. This, however, appears to be somewhat doubtful, as Edwards, in his

"Voyage up the Amazon," states that he never observed this action, although the Toucans, on taking fruit into their bills, always throw the head back, and thus allow their food to find its way to its destination.

When roosting, the Toucans frequently throw their tails over their backs in a very singular manner, and, when sitting quietly at rest, their enormous bill usually lies in a horizontal position, giving the bird a lazy, grave aspect. According to Lesson, this habit of the birds has induced the negroes of the French colonies to give them the name of *oiseaux-prêcheurs*, or preaching birds. They nidificate, like the Parrots, in holes of trees, and lay two roundish white eggs.

The family exhibits two principal forms—the true Toucans, forming the genus *Rhamphastos*, and the Aracaris, which have been divided into several genera, of which, however, the genus *Pteroglossus* is the principal. The latter are distinguished from the true Toucans by the much smaller size of the bill, which in some instances is scarcely larger in proportion to the bird than that of a Raven, but in other respects and in habits there appears to be very little difference between them. The Toucans are almost always black, with patches of white, or of bright colours upon different parts of their bodies, especially under the chin; the Aracaris, on the contrary, are usually green, with red or yellow upon the breast. The bill in both groups is generally adorned with beautiful colours, but these often disappear completely after death.

## Order VII.—Passeres.

**General Characters.**—The Passerine Birds, corresponding with the *Insessores* of many authors, constitute the most numerous and varied order of birds. They approach closely to the Scansorial birds, which, in fact, might perhaps with propriety be united with them to form a single order, as the principal distinction consists in the structure of the feet, which in the Passeres possess four toes,—three directed forwards, and one backwards. This distinction is, however, more apparent than real, as several of the Passerine birds have the power of turning one of the toes backwards at pleasure; and the Cuckoos, as we have already stated, can turn one of their hind toes forwards. The tarsi and toes are always scutellate, and the hinder portion and sides of the former are usually covered with a single horny plate, which is also sometimes the case with the anterior surface of this part of the leg. The toes have no basal membrane, but the outer toe is usually united to the middle one at its base, and sometimes, as in the King-fishers, nearly to the extremity. The legs and feet are generally slight, and the claws, although curved, never constitute powerful hooked talons, as in the predaceous birds. The feet are especially adapted for perching, and when on the ground the birds rarely walk, but generally move by hopping with both feet simultaneously.



Fig. 105.—Foot of the Carrion Crow (*Corvus corone.*)

The power of flight is possessed in great perfection by most of these birds; the

wings are large and powerful, and the crest of the sternum very well developed. The primary quill feathers of the wing are generally ten in number; but the first of these is frequently wanting, or very small. The tail is usually composed of twelve quill feathers.



Fig. 196.—Head of the Sparrow (*Passer domesticus*).

The bill is very variable in form, sometimes elongated and slender, sometimes stout and conical, or depressed and opening with a very wide gape. The upper mandible is frequently more or less toothed near the tip From these peculiarities in the form of the bill the primary classification of these birds most generally in use is derived, each form being characteristic of a group or sub-order. Thus, the birds with a stout conical bill, in which the upper mandible is not distinctly toothed form the sub-order *Conirostres*, in which the bill is usually employed in crushing hard seeds; those with a somewhat similar bill, but toothed, and usually more or less hooked at the tip (Fig. 197), are called *Dentirostres*, and feed principally upon insects and fruits; those which have the bill elongated and awl-shaped (Fig. 198) feed upon soft larvæ and the juices of flowers, and form the sub-order *Tenuirostres*. And those in which the bill is more or less depressed with a very wide gape (Fig. 199) are called *Fissirostres*: they feed upon insects, which they capture on the wing.



Fig. 197.—Head of the Gray Shrike (*Lanius excubitor*).

The œsophagus in these birds is usually dilated into a sort of crop; the stomach forms a powerful muscular gizzard, and the intestine is furnished with two cœca, which are generally very

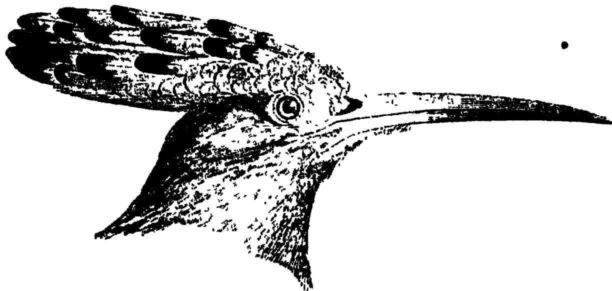


Fig. 198.—Head of the Hoopoe (*Upupa epops*).

small. Many of them are also characterized by the presence of a complicated muscular apparatus at the lower larynx, which enables these birds to produce their charmingly modulated notes; and of such importance does this character appear to some authors, that they have divided the Passerine birds into two orders, according as they were furnished with, or destitute of this apparatus. It is to be observed, however, that many of the birds in which these muscles are found are by no means celebrated for the sweetness of their voices; for instance, the Crows possess the singing apparatus, and are consequently placed amongst the singing birds in the arrangements above referred to.



Fig. 199.—Head of the White-bellied Swift (*Cypselus melba*).

**Divisions.**—The classification of this order of birds presents considerable difficulties, and is still involved in some uncertainty. Very various schemes have been put forward by different authors for the arrangement of the almost interminable series of Passerine birds; but most of them admit the four principal divisions of *Conirostres*, *Dentirostres*, *Tenuirostres*, and *Fissirostres*, to which I have already referred. Cuvier, to whom we are indebted for the establishment of these groups, adopted a fifth division, that of the *Syndactyli*, in which the two outer toes are united for the greater part of their length; this group, however, included birds of very different descriptions, and has since been suppressed by many authors. It must be confessed, however, that the boundaries of these great divisions are not so well marked as might be desired, and the true position of many of the subordinate groups is still a matter of doubt. In the following pages we have, with but few exceptions, followed the classification adopted by Mr. G. R. Gray in his valuable work on the "Genera of Birds," as is also the case with the preceding orders.

### Sub-order I.—Conirostres.

**General Characters.**—In the Conirostral birds, as already stated, the bill is of a more or less conical form, sometimes short, very thick at the base, and rapidly diminishing to the tip—in other cases it is more elongated and tapering, and sometimes slightly curved. The tip of the upper mandible is usually entire, but occasionally there is a slight tooth on each side, near the extremity. The wings are generally *longish and pointed, the tarsi long, and the toes of moderate length, the outer one* being frequently united at its base to the middle one.

This group includes the essentially granivorous birds, but a considerable number of the species referred to it are not confined to a grain diet, many of them feed upon fruits and insects, and larvæ also form a portion of the nourishment of most of the species. *Some, such as the Crows and their allies, appear to feed upon almost any* animal or vegetable substances that come in their way, and these constitute the greater part of Temminck's order of *Omnivores*, which includes no less than five of the families.

**Divisions.**—The Conirostres form eight families, of which the first seven, with the

exception of the *Musophagidæ* and *Coliidæ*, form the order *Omnivores* of M. Temminck, a group which has not been adopted by any subsequent naturalists. The first family, that of the *Buceridæ*, or Hornbills, like the Toucans in the preceding order, is distinguished by the great size of the bill in the birds of which it is composed, and this organ is usually rendered still more remarkable by a singular casque or helmet which surmounts its base (Fig. 200). This curious appendage, which is often of very large size, and, from its external appearance, would be supposed to be of a bony texture, is composed, like the bill of the Toucans, entirely of air cells, and is often so fragile that when a dried specimen is handled incautiously it is very liable to be crushed. The bill itself is considerably curved, and rather acute at the apex; the nostrils are situated at its base; the wings are of moderate size, the tail long and broad, the tarsi short and stout, and the toes more or less united at the base, the outer toe especially being attached to the middle one to such a distance that Cuvier included these birds with the Kingfishers and some others in his group of *Syndactyli*.



Fig. 200.—Hornbill (*Buceros*).

The Hornbills are generally of tolerably large size, some of them being of the stature of a small Turkey. Their general colour is usually a greenish metallic black, with the neighbourhood of the vent, the tail-coverts, and the tail white, or of some other light colour; the tail generally has a black transverse band near the extremity. They are inhabitants of the hottest parts of the Old World, and especially of the islands of the Eastern Archipelago and Africa. Their food consists of fruits, and, according to some naturalists, also of carrion and small animals, the latter of which they are said to squeeze to death in their enormous bills, and then throwing them up in the air, catch them and swallow them whole. Lesson states that the African species live on carrion, and those of the East Indies on fruits, and especially on nutmegs, from which, he says, their flesh acquires a delicious flavour. They are found in the dense forests and jungles, where they sit upon the highest branches of the trees, often in large troops; their nesting places are the holes of trees, which, like the Parrots and Toucans, they enlarge for the purpose of nidification; the female lays four eggs. Their flight is effected by a very rapid motion of the wings, which produces a considerable noise; this is accompanied by a continual clattering of their mandibles, so that the passage of a flight of Hornbills causes a sound which is said to be productive of very uncomfortable sensations when its origin is unknown, as it bears a good deal of resemblance to one of those sudden violent winds which often rise unexpectedly in the tropics.

The second family is that of the *Musophagidæ*, or Plantain-eaters, a group of birds which is exclusively confined to Africa. They have the bill of moderate size, broad at the base, compressed, with the ridge much curved, and the tip strongly notched; the tarsi are stout, covered in front with broad scales, and the toes are long, the outer one

being capable of being turned backwards, for which reason many authors have placed them amongst the Scansorial birds.

The best known species are the Touracos (*Corythaix*), distinguished by having the bill of ordinary form, and the head ornamented with an erectile crest. These birds are generally of a green colour, with the quill feathers of the wings and tail violet or red. They are elegant birds, about the size of a pigeon, and are said to be so fearless that they will accompany a man, flying from branch to branch, and uttering cries which are supposed to indicate pleasure. They feed principally upon fruits, but appear also to pick up insects.

The Touracos are found in most parts of Africa, where they inhabit thickly-wooded places, and nidificate in holes of trees They are monogamous, and both sexes assist in incubation.

The Plantain-eaters (*Musophaga*) are larger birds than the Touracos, and appear to be confined to the tropical regions of Africa. They receive their name from their great predilection which they exhibit for the fruits of the banana and plantain. They are distinguished by the singular conformation of the bill, the base of which forms a broad plate covering the forehead. Their colours are exceedingly beautiful.

The third family, that of the *Opisthocomidæ*, closely resembles the preceding in most of its characters, and is, in fact, placed by Mr. G. R. Gray as a sub-family of that group; it differs, however, in the incapability of the outer toe to be turned backwards. It includes only a single species, the Hoatzin (*Opisthocomus cristatus*), a native of Brazil and Guiana, where it lives in large flocks on the banks of rivers and creeks, and feeds almost entirely on the leaves of a particular tree, the *Arum arborescens* of Linnæus. It nidificates in the lower parts of trees; its nest is composed of twigs, and lined with soft materials, and the female lays three or four eggs of a dirty white colour, with scattered red spots. Both the bird and its flesh are tainted with a peculiar odour, which prevents its being used as food.

The position of this singular bird has always been a matter of doubt with ornithologists. Linnæus described it as a Pheasant, and several other authors have placed it amongst the Gallinaceous birds; but it is now generally regarded as a true Passerine bird. It is nearly as large as a Peacock, which it also resembles in its walk. The bill is thick, short, convex, and bent down at the tip; the base is furnished with diverging bristles, and the nostrils are placed in the middle of the bill. The head is adorned with a tuft of long, narrow feathers.

Another small family, placed in the neighbourhood of the Musophagidæ by Mr. G. R. Gray, although its type has generally been regarded as a member of the family *Fringillidæ*, is that of the *Coliidæ*, or Colies, a group of small birds, in which the bill is short and stout, elevated at the base, with the nostrils placed in the middle of a large membranous groove. The wings are short, the tail elongated, and the true hinder toe is directed forwards. The Colies are found in Africa and India. Their plumage is soft and silky, and usually of a gray colour, whence, according to Levaillant, they are called *mouse-birds* at the Cape of Good Hope. They live in troops, feeding on fruits and the buds of trees, and climbing about the branches with great agility, using their bills in the same way as the Parrots. They make a large, rounded nest, and lay five or six eggs. Levaillant states that when sleeping they suspend themselves with the head downwards, and that in cold weather they are often found in the morning so completely benumbed, that they may be taken, one after the other, by hand. Their flesh is said to be delicate.

The fifth family of the Conirostral birds is that of the *Corvidæ* or Crows. In these birds the bill is long, strong, and compressed, with the ridge of the upper mandible more or less curved, and the tip more or less notched; the nostrils are placed at the base and concealed by the basal plumes; the wings are usually long, and the tarsi and toes of moderate length,—the former being covered in front with broad plates.

These birds may be regarded as the typical examples of Temminck's order *Omnivores*, as they feed not only upon grain and fruits, but also upon animal substances, and even upon carrion. They walk and run with greater facility than any others of the Passerine birds, but are also perfectly at home in the trees, and generally fly well. They all form a large nest of sticks, lined with soft materials, and their eggs, which vary from three to seven in number, exhibit dark spots upon a pale bluish, greenish, or white ground. Mr. G. R. Gray divides these birds into six sub-families, three of which possess representatives in the British Fauna.

The *Streperinæ* or Piping Crows, a group of rather large birds which inhabit New Holland, New Guinea, and the adjacent islands, are distinguished from the other Corvidæ by the form of the nostrils, each of which consists of a long narrow slit in the substance of the bill, and is usually completely exposed. The bill itself is long and compressed, broad at the base, where the ridge projects upon the forehead, and the tip is more or less notched. Unlike the ordinary members of their family, these birds have a peculiar musical note. One species, the *Gymnorhina tibicen* or *flute-player*, is common in New South Wales, where it is said to be very noisy and to live upon animal substances, including small birds.

A second group is the sub-family of the *Garrulinæ* or Jays, which have also a slight notch near the tip of the upper mandible, but the nostrils are concealed under the frontal plumes; their wings are of moderate size and rounded, and their tarsi and toes strongly scutellated.

The common European Jay (*Garrulus glandarius*, Fig. 201), is an exceedingly handsome bird, about the size of a pigeon, of a light reddish-brown colour, with the primary wing-coverts bright blue, elegantly banded with black. The feathers of the fore part of the head are whitish, spotted with black, and elongated so as to form a crest, which the bird can erect at pleasure; the quill-feathers of the wings and tail, and a streak on each side of the chin are black.

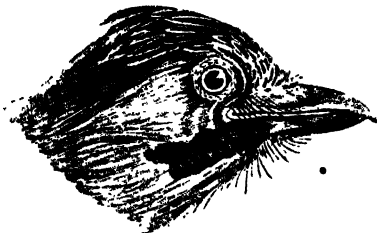


Fig. 201.—Head of the Jay (*Garrulus glandarius*).

The Jay is a common bird in England and the southern parts of Scotland; it inhabits thick woods, and is shy in its habits. It feeds to a great extent upon vegetable matters, such as acorns and beech-mast, and in summer often visits gardens, tempted by the cultivated fruits. It also feeds on insects and worms. Its nest is formed in tall bushes, or in the lower branches of trees; but always well concealed amongst the leaves. It is cup-shaped, formed of small sticks, and lined with finer materials, such as small roots and grass; the eggs are five or six in number.

The natural note of the Jay is a harsh grating sound; but its powers of imitation

are exceedingly great, and even in a state of nature it has been known to mimic the voices of other animals so exactly that it was difficult to believe that the animals personated were really absent. Montagu says, that in the spring the Jay will sometimes utter a sort of song, which he describes as soft and pleasing, but into which it introduces at intervals the bleating of a lamb, the mewing of a cat, the note of a kite or buzzard, the hooting of an owl, and even the neighing of a horse and similar sounds. In confinement, of course, a wider field is opened for the bird's talents for mimicry; and it usually takes advantage of its position to pick up and repeat every sound with which it is familiar. Thus, Bewick mentions a Jay that imitated "the sound of a saw so exactly that, though it was on a Sunday, we could hardly be persuaded that there was not a carpenter at work in the house."

Mr. Yarrell also refers to one of these birds, in the possession of a surgeon in Berkshire, which, before it was twelve months old, imitated the ordinary household sounds with astonishing accuracy. He would give what might be called a poultry-yard entertainment, imitating the calling of the fowls to feed, and all the noises of the fowls themselves in perfection; but the crowing of the Cock was not managed so well. The barking and noises of the house-dog were imitated in a style that could not be distinguished from the original.

The Jay is found all over the temperate parts of Europe, and several other species of its genus are inhabitants of different parts of the Eastern Hemisphere. In North America, its place is taken by an exceedingly elegant bird, the Blue Jay (*Cyanurus cristatus*), which appears to resemble the European species very closely in its habits. It is a lively bird, and appears to delight in mischief and fun; it will imitate the notes of almost every other bird, and finds an especial pleasure in teasing the American Sparrow-hawk, or in leading the small birds of the neighbourhood to expel some unlucky owl from their domains. Like his European relative, however, the Blue Jay is addicted to robbing the nests of other birds and sucking their eggs; and Wilson mentions having seen one for more than five minutes in active pursuit of a small bird, which, however, ultimately escaped. A nearly allied species, but far inferior in beauty, is found in Canada; it is the *Perisoreus Canadensis*.

The Tree Crows (*Callæatinæ*), form a third sub-family. In these, the upper mandible is not toothed at the tip, the bill is short, with the ridge much elevated at the base, and considerably curved; the wings are short and rounded, the tail long, the tarsi covered with transverse scales, and the two lateral toes are unequal. These birds are peculiar to the Eastern Hemisphere, of which they generally inhabit the warmer regions. The typical species, *Callæas cinerea*, sometimes called the New Zealand Crow, is, as its name implies, an inhabitant of our antipodes. In its habits it resembles the ordinary Crows, feeding on fruits, insects, and occasionally on small birds; its general colour is a greenish-black, and on each side of the head there is a small wattle of a bright blue tint.

From these we pass to the sub-family of the True Crows (*Corvinæ*), to which the greater part of the British species of Corvidæ belong. These birds, like the preceding, are destitute of the teeth at the tip of the upper mandible, the ridge of which is more or less curved; the wings are long and very slightly rounded, the tail variable in form, the tarsi long and covered with transverse scales, and the two lateral toes are equal.

The birds of this sub-family are undoubtedly the most intelligent of the feathered races. In a state of nature, they are exceedingly wary, and appear not only to have

an instinctive perception of the approach of peril, but also to know the extent of the danger to which they are likely to be exposed. Thus, some of them will allow an unarmed man to come very near them without appearing at all alarmed at his approach; but it requires the greatest caution to get within gunshot of them, when the intruder is furnished with fire-arms. When taken young they are very docile, and may be taught to repeat a few words, although their elocutionary powers are far inferior to those of the Parrots. Their cunning and apparent drollery of disposition, however, often render them very amusing pets, although it must be confessed that, like Autolycus, they have a knack of picking up "unconsidered trifles," which may occasionally lead to disagreeable results. In the abstraction and concealment of the articles which they appropriate in this manner,—usually trinkets and other metallic and glittering prizes,—which can be of no possible use to the bird, they exhibit the most extraordinary slyness, and it is generally with considerable difficulty that the concealed treasury of one of these corvine pets can be discovered. For want of other things to hide they will often stow away portions of their meat, but this is sometimes done with a view to preserve it for a future occasion. Mr. Macgillivray mentions an instance of the accurate memory of a Carrion Crow (*Corvus corone*) with regard to the place in which he had stored some food. One Monday morning, after a full meal, he picked up a dead mole, and buried it in his owner's garden, covering it over so neatly with the earth, that although he had been watched during the operation of inhumation, the precise spot could not be discovered. He was prevented from going into the garden during the whole of the following week; but on Saturday evening, the door being left open, he got in, went directly to the spot where he had buried the mole, and brought it out immediately.

An interesting instance of the intelligence and *kindliness* of a Raven is related by the late Bishop of Norwich, in his "History of Birds," as having occurred at the Red Lion Inn, at Hungerford. The story, as told by a gentleman who lodged there, was as follows:—"Coming into the inn-yard," said he, "my chaise ran over and bruised the leg of a favourite Newfoundland dog, and while we were examining the injury, Ralph, the Raven, looked on also, and was evidently making his remarks on what was doing; for the minute my dog was tied up under the manger, with my horse, Ralph not only visited him, but brought him bones, and attended him with particular marks of kindness. I observed it to the ostler, who told me that the bird had been brought up with a dog, and that the affection between them was mutual, and all the neighbourhood had been witnesses of the many acts of kindness performed by the one to the other. Ralph's friend, the dog, in course of time, had the misfortune to break his leg, and during the period of his confinement the Raven waited on him constantly, carried him his provisions, and scarcely ever left him alone." This bird was said to be always very kind to dogs, especially when maimed or wounded in any way.

Lieutenant Burgess gives an anecdote illustrative of the sagacity of the common Indian Crow (*Corvus splendens*) exercised in a very different direction from that of the Raven above referred to. He says—"Some crows had been sitting near a young dog, watching him whilst engaged with a bone. Having apparently concerted the plan, one of them alighted, stepped up, and took a peck at the dog's tail; the dog, irritated, made a snap at the bully; on which a comrade, who appears to have been ready, made a dash and went off with the prize." The tails of dogs appear to be always favourite points of attack with domesticated crows of all kinds, and they will sometimes lie in conceal-

ment waiting for a dog to pass them, when they rush out and pinch his tail. This, however, appears to be done purely for amusement.

These birds are exceedingly voracious, and no kind of eatable matter appears to come amiss to them. Many of the species feed to a great extent upon the carcases of animals which may have died from disease or accident, and in some instances they are said to hasten the death even of such a large animal as a sheep when they find it in an exhausted condition. The Raven (*Corvus corax*) and the Carrion Crow are also charged with destroying young lambs; and it is well known that both these species not only make great havoc amongst the eggs and young of other birds, but will also capture full-fledged birds, and occasionally half-grown hares and rabbits. Carrion of all kinds, however, constitutes the staple food of the three larger species of Crows found in Britain, the Raven, the Carrion Crow, and the Hooded Crow (*Corvus cornix*), and in the search for this they exhibit the greatest activity, and often arrive in great numbers at a spot where there is an abundant supply of food. It has been supposed that the birds are guided to their repast by the sense of smell, but this appears very doubtful, and it is more probably to the eye that they are indebted for an early intimation of the prospect of a feast; Mr. Macgillivray supposes that the individuals which arrive from a distance may have been led to undertake their journey by seeing others in motion in the same direction. However this may be, it is certain that when a large supply of food is to be had in a particular spot, the Ravens which come to partake of it must have assembled from a distance of many miles.

When on the ground the Crows usually walk along in a very sedate manner, which has suggested to the lively fancy of Mr. Charles Dickens, a resemblance between a Raven and an old gentleman with his hands under his coat tails; but occasionally, and especially when disturbed, or engaged in carrying off a fragment of food or some other article, they hop in a most ludicrous manner, making use of the wings at the same time. Their flight is steady and tolerably rapid, and they often sail in the air with extended wings. Their voice is generally harsh and disagreeable, and is either a sort of hoarse croak, or a sound bearing more or less resemblance to the word *caw*.

The three species above mentioned, which are the largest and the most decidedly carnivorous in their habits, generally lead a solitary existence, and are rarely seen in any numbers together, unless attracted by an extraordinary supply of food. The two other British species of *Corvus*, namely the Rook (*Corvus frugilegus*, Fig. 202), and the Jackdaw (*C. monedula*, Fig. 203), are gregarious in their habits, and the food of these consists rather of worms, insects, and larvæ, than of carrion.



Fig. 202.—Head of the Rook (*Corvus frugilegus*).

The Corvinæ breed early in the spring. Their nests are composed of twigs and similar materials, lined with wool and feathers; they are usually of considerable size and placed at a good height from the ground, either in trees, rocks or buildings. The Raven and the Carrion Crow build either in trees or on rocks, according to the district

in which they reside. The Hooded Crow is said always to build amongst rocks, and during the breeding season, as at other periods, these birds are solitary in their habits. The two gregarious British species of the genus *Corvus*, also build their nests and bring up their young in close proximity,—the Rook selecting trees for this purpose, and the Jackdaw usually frequenting elevated buildings, such as church towers, about which it is often to be seen, even in the heart of cities.

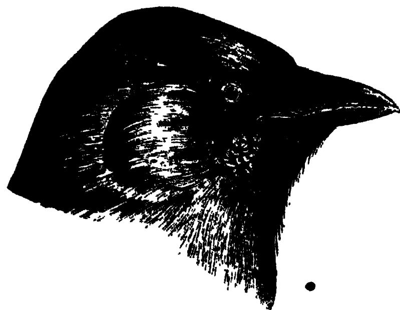


Fig. 203.—Head of the Jackdaw (*Corvus Monedula*).

Besides the five species of true *Corvi* above referred to, we have in Britain two other members of the group. One of these is the Magpie (*Pica caudata*, Fig. 204), the handsomest of our native Crows, distinguished by its long tail and its plumage elegantly varied with black and white. It is generally distributed in all the wooded districts of Britain, and is found abundantly in all parts of Europe; it also occurs in North America. It exhibits all the cunning and sagacity of the group, and in this country, where it appears to labour under a sort of proscription, is an exceedingly shy and wary bird; but in most continental countries, from its being treated with more consideration, it acquires great familiarity, and in some places feeds in the immediate vicinity of the houses without the least fear. Its food resembles that of the other Crows, but appears to consist less of carrion than that of some of the other species. It frequently destroys young birds, and plunders its neighbours' nests.

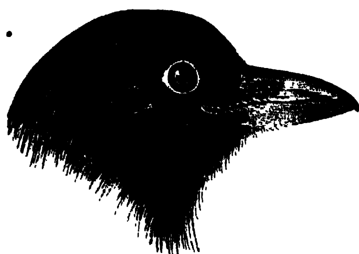


Fig. 204.—Head of the Magpie (*Pica caudata*).

The nest of the Magpie is more artificially constructed than that of the other species of Corvinæ. It is usually constructed in high trees; but sometimes in thick hedges. It is large and of an oval form, composed externally of sharp thorny twigs, which form a complete dome over the top, leaving a small opening at one side for the ingress and egress of the bird. The inside is plastered with a layer of mud, and the bottom lined with grass and fibrous roots to form a soft receptacle for the eggs and young. The Magpie breeds in the spring.

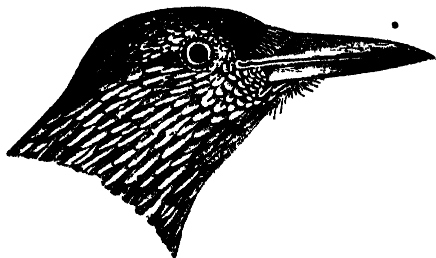


Fig. 205.—Head of the Nutcracker (*Nucifraga caryocatactes*).

The only other indigenous species of this sub-family is the Nutcracker (*Nucifraga*

*caryocatactes*, (Fig. 205), a bird about the size of the common Jay, with brown plumage covered with oblong, white spots. This bird, although not uncommon in some parts of Europe, is rare in this country, to which it appears to be only an occasional visitor. On the continent it is said to inhabit mountainous districts clothed with firs, the seeds of which, with beech-mast, nuts, and insects constitute its general food. It is said to crack nuts by fixing them in a fissure of the bark of trees and then hammering at them with its bill; and from this supposed habit the name of the bird is derived; but a living specimen in the Menagerie of the Zoological Society was found to be incapable of cracking nuts, although he was very fond of the kernels when extracted for him. In some respects this bird appears to connect the Crows with the Starlings, but some of its habits would seem to point to an affinity with the Woodpeckers. Thus the continental naturalists say that it runs upon the bark of trees like a Woodpecker, and it nidificates in holes of trees, which it enlarges with its bill in the same manner as the Scansorial birds in general. The Nutcracker is found not only in Europe, but in the extensive pine forests of the north of Asia, as far as Kamtschatka.

Many of the exotic species of this group are adorned with fine colours; but in their general habits they resemble the birds already described. Some of them, such as the *Picathartes gymnocephalus*, have the head bare of feathers, a character which has caused them to be compared with the Vultures.

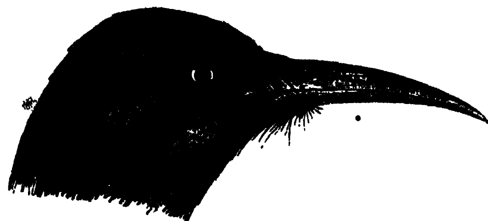


Fig. 206.—Head of the Cornish Chough (*Fregilus graculus*).

The last sub-family of Crows is that of the *Pyrrhocoracinæ* or Choughs, which differ from the true Crows in having the bill slightly notched at the tip, and the wings long and pointed. The bill is long, slender, and curved; the tail is long; the tarsi short, rather stout, and either scaled or nearly covered with a single long plate (Fig. 207), and the lateral toes are equal.

These birds, in their general habits, closely resemble the Crows, and especially the common Jackdaws. Like these, they are gregarious, and build their nests in rocks and the crevices of towers, steeples, &c. They feed principally upon insects, worms, fruits, and seeds.

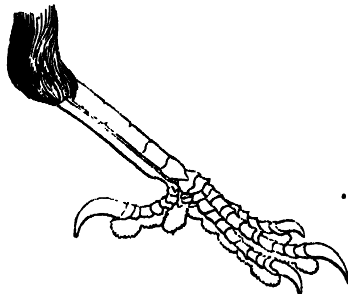


Fig. 207.—Foot of the Cornish Chough.

Two species only occur in Europe, and of these one is found in Britain. This is the Cornish Chough (*Fregilus graculus*, Fig. 206), so called from its being of common occurrence in the county of Cornwall, to which it was at one time supposed to be peculiar; it has since been met with in many other parts of the kingdom, but generally on the coast. On the continent, however, it inhabits the mountainous districts at a distance from the sea. This bird

exhibits all the curiosity and love of mischief so characteristic of the family of Crows; but appears to be somewhat inferior to the rest in sagacity. At a little distance the Chough bears a considerable resemblance to the Rook; but is easily distinguished from that bird by its red legs and bill. From the former of these characteristics it has been called the Red-legged Crow.

The other European species, the Alpine Crow (*Pyrrhocorax alpinus*), exactly resembles the common Chough in its habits; but lives entirely upon the bare face of the highest mountains, close to the line of eternal snow. In the winter, these birds descend into the valleys in large flocks in search of food. Several other species are found in different parts of the world.

Nearly allied to the Corvidæ, with which they are indeed amalgamated by some ornithologists, is the magnificent family of the *Paradiseidæ*, or Birds of Paradise, some species of which are so well known as amongst the most *récherché* ornaments of female dress. In the general form of the bill and the position of the nostrils, which are concealed under the basal plumes, these birds closely resemble the Crows; the tip of the upper mandible is notched; the wings are long and rounded; the tarsi long and stout, covered in front by a single plate; the toes are long and strong, the outer one being longer than the inner, and united at the base to the middle one by a small membrane, the hind toe is very long, and the claws large and curved.

One of the most remarkable characteristics of these magnificent birds consists in the great development of some of the feathers, usually those of the sides of the body and neck, which often gives these creatures a most remarkable appearance. These ornaments consist sometimes of large bunches of decomposed plumes, which float lightly in the air, as in the Great Emerald Bird of Paradise (*Paradisea apoda*), which is the common species imported into Europe for ornament, whilst in other cases they are shield-like discs of feathers, shining, with the most beautiful metallic tints. The tail is also generally furnished with two or more elongated filaments of a horny texture, usually more or less twisted at the extremity, where they are also sometimes furnished with short barbs. All these decorations, however, are possessed only by the males, as in the Gallinaceous birds, which the Birds of Paradise are also said to resemble in the practice of polygamy; and it is certain that the male Bird of Paradise displays himself before the female very much in the manner of the



Fig. 208.—Superb Bird of Paradise (*Paradisea superba*).

Peacock. M. de Lafresnaye has published the following account, received from one of his friends, of the behaviour of the Emerald Bird of Paradise (*P. apoda*) which had been seen by him in confinement in Batavia. He says that "the males of this bird display themselves before the female, expanding the long plumes of their flanks. By means of a sort of vibration of their entire plumage, they raised all their feathers, including these long plumes, and surrounded themselves completely, so as to form a sort of halo, in the centre of which the bright green head formed a disc, which at the moment looked like a little emerald sun, with its rays formed by the feathers of the two plumes."

In the genus *Epimachus*, belonging to the Tenuirostral birds, the same development of the plumage occurs as amongst the Birds of Paradise, with which, in fact, they were formerly confounded by many authors.

These birds are found only in the most distant parts of the Eastern Archipelago, in New Guinea, and the adjacent islands. Here they live in large troops in the dense forests, preferring to rest upon the teak trees, the large leaves of which afford them a shelter from the heat of the mid-day sun, whilst its fruit constitutes a considerable portion of their nourishment. According to M. Lesson, they are birds of passage, shifting from one district to another with the monsoon. "The females," says the same author, "unite into bands, assemble at the tops of the highest trees of the forest, and cry simultaneously to call the males. The latter always occur singly in the midst of about fifteen females, which compose their seraglio." The voice of the male is very loud and piercing, resembling the sounds *voike, voike, voike, voiko,* strongly articulated. The cry of the female is similar, but weaker.

Of the beautiful appearance of the Bird of Paradise in its native forests, the following extract from M. Lesson's works, although, perhaps, a little romantic, may give some idea. On landing in New Guinea, he says, "Scarcely had I proceeded a few hundred paces into these ancient forests, the sombre gloom of which is perhaps the most magnificent and pompous spectacle that I have ever seen, when a Bird of Paradise attracted my attention; it flew with. grace, and in an undulating manner; the feathers of its sides formed a graceful and airy plume, which, without hyperbole, bore no distant resemblance to a brilliant meteor. Struck with surprise and admiration, I feasted my eyes upon this magnificent bird with inexpressible pleasure; but my disturbance was so great that I forgot to fire at him, and did not perceive that I had a gun until he was far away."

The natives of New Guinea kill a great number of the Emerald Bird of Paradise, the dried skins of which they sell to the Malays, and thus they reach Europe in a somewhat round-about manner. They take them in the night, by climbing into the trees upon which they roost, and kill them with short arrows. They then dry them by a fire after cutting off the legs; and from the circumstance of all the specimens arriving thus mutilated, Linnæus gave the species the name of *Paradisea apoda* or the footless Bird of Paradise, a name which was long popularly supposed to be literally applicable to it. Linnæus himself was well aware that the bird was not deficient of feet, for he expressly states that the older writers *falsely* described it as wanting those organs.

We come now to the family of the *Sturnidæ* or Starlings, of which our common Starling is a well-known example. In these birds the bill is elongated and compressed, with the ridge nearly straight to near the tip, where it is curved or convex. The edge of the upper mandible is usually slightly notched. The wings are long and

more or less pointed; the tarsi stout, covered in front with broad scales, and the toes are long and strong, especially the hind one, which is stouter than either of the lateral toes. The outer toe is united to the middle one as far as the third joint. In their habits and food these birds approach very closely to the smaller species of Corvine birds. They are generally gregarious, and feed upon worms, insects, fruits, and seeds. They are docile in captivity, when they exhibit on a small scale a good deal of the peculiar sagacity of the Crows, and may be taught to repeat a few words, and to whistle short tunes.

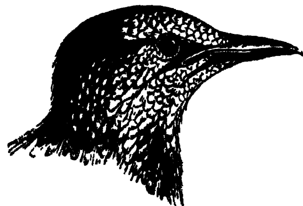


Fig. 209.—Head of the Starling (*Sturnus vulgaris*).

Of the numerous sub-families into which Mr. G. R. Gray divides these birds, one of the most interesting is that of the *Ptilonorhynchinæ* or Glossy Starlings, to which the singular Bower-bird of Australia belongs. The birds of this group have the bill stout and compressed, with the ridge curved and the tip notched: the wings are of moderate length and pointed; the tarsi strong, and all the toes long and robust, the lateral ones being unequal.

These birds are peculiar to the Eastern Hemisphere, of which they generally inhabit the hotter parts. The majority are found in India, Australia, and the intervening islands, but Africa also possesses a few species belonging to the genus *Juida*. They inhabit the hot regions of that continent, where they fly in large flocks, feeding principally on fruits, and often attacking the gardens and vineyards, to which they do great damage. They also devour insects and worms, and are sometimes seen perched on the backs of cattle, searching for the parasitic insects amongst their hair. The *Juidæ* are generally showy birds, with a metallic lustre upon their plumage, rather larger than our common Starling, and with a much longer tail. They nestle in rocks and holes of trees, and lay five or six eggs.

The singular Bower-birds of Australia belong to the genera *Ptilonorhynchus* and *Chlamydera*. These birds are remarkable for the habit of making a sort of bower, which has nothing to do with their nidification, but merely serves as a sort of playing ground, in and around which the birds assemble for amusement. The birds inhabit the forests of Australia, and the bower is placed under the shelter of some large tree. Mr. Gould describes the construction and use of that of the Satin Bower-bird (*Ptilonorhynchus holosericeus*) in the following words :—"The base consists of an extensive and rather convex platform of sticks firmly interwoven, on the centre of which the bower itself is built; this, like the platform on which it is placed and with which it is interwoven, is formed of sticks and twigs, but of a more slender and flexible description, the tips of the twigs being so arranged as to curve inwards and nearly meet at the top; in the interior of the bower the materials are so placed that the forks of the twigs are always presented outwards, by which arrangement not the slightest obstruction is offered to the passage of the birds. For what purpose these curious bowers are made is not yet, perhaps, fully understood; they are certainly not used as a nest, but as a place of resort for many individuals of both sexes, which, when there assembled, run through and around the bower in a sportive and playful manner, and that so frequently that it is seldom entirely deserted." A still more extraordinary structure of the same description is formed by the Spotted Bower-bird (*Chlamydera*

*maculata*), an inhabitant of the interior of Australia; it is thus described by Mr. Gould. The bowers "are considerably longer and more avenue-like than those of the Satin Bower-bird, being in many instances three feet in length. They are outwardly built of twigs, and beautifully lined with tall grasses, so disposed that their heads nearly meet; the decorations are very profuse, and consist of bivalve shells, crania of small mammalia and other bones. Evident and beautiful instances of design are manifest throughout the bower and decorations formed by this species, particularly in the manner in which the stones are placed within the bower, apparently to keep the grasses with which it is lined fixed firmly in their places: these stones diverge from the mouth of the run on each side, so as to form little paths, while the immense collection of decorative materials, bones, shells, &c., are placed in a heap before the entrance of the avenue, this arrangement being the same at both ends." Mr. Gould adds, in evidence of the labour that must be bestowed by the birds upon the construction of these apparently useless assembly rooms, that he frequently found them at a distance from any river, so that the shells and small stones employed in their fabrication must have been transported from a considerable distance. It appears also that the birds only collect bones which have been bleached in the sun; and it is certain that as the birds feed almost entirely upon fruits and seeds, these remains of other animals cannot be regarded as relics of their victims. Figures of these birds, with their bowers, will be found in Mr. Gould's valuable work on the "Birds of Australia."

The second sub-family is that of the Grakles (*Graculinæ*), a group of birds found only in the jungles of India and the Indian islands. In these the bill is broad at the base, and slightly notched at the tip, with the ridge a little curved; the nostrils are rounded, placed at the base of the bill, and more or less covered by the frontal plumes; the wings are long, with the third and fourth quills longest; the tail short, the tarsi short, and the toes long. The typical species of this group is the *Gracula religiosa* of Linnæus, which inhabits Java, Sumatra, and some of the other large islands of the Eastern Archipelago. It is two or three inches in length; its plumage is of a deep velvet-like black colour, with a white mirror upon each wing; and the bill and feet are yellow. Behind each eye there are some caruncles of a bright yellow colour. It lives on fruits and insects, and may be domesticated with facility, when it soon learns to whistle and speak admirably. M. Lesson mentions that he saw a specimen in Java, which pronounced whole sentences in the Malay language. The other species appear to resemble this in their habits.

Africa possesses another peculiar group of these birds, which, from their remarkable habits, have received the name of *Buphaginæ*, or Ox-peckers. They have a stout bill, with the ridge somewhat depressed and curved at the tip, which has no notches; the nostrils are small, and partly closed by a membrane; the wings long and pointed; the tail long, with the end of each feather pointed; the tarsi and toes are robust, the latter armed with compressed, curved, acute claws.

This group includes only a very few species of birds, belonging to a single genus, inhabiting the warmer parts of Africa. The best known species is the *Buphaga Africana*, the common Ox-pecker or Beef-eater, so called from its singular habit of perching on the backs of cattle, and extracting the larvæ of the Bot-flies (*Œstridæ*), by which those quadrupeds are commonly infested. Singular as this diet may seem, it is said to constitute the principal nourishment of these birds; and the bill is certainly peculiarly adapted for gently squeezing the parasites out of the tumours caused by their presence. The cattle are said to allow the birds to perch upon them without any

signs of unwillingness. The common Ox-pecker is a small bird, about eight or nine inches in length; its plumage is reddish-brown above and yellowish-white beneath; the legs are brown and the bill yellowish, with the tips of both mandibles red. It is generally seen associated in small flocks of seven or eight individuals, and is exceedingly shy.

We come now to the typical group, the sub-family of the *Sturninæ*, or True Starlings, to which our British species belongs. In these birds the bill is usually elongated, rather slender and tapering, with the ridge very slightly curved or straight, and the tip obtuse, somewhat flattened and furnished with a very indistinct notch on each side; the nostrils are placed at the base of the bill, in a membranous groove; the wings and tail are rather short; the tarsi long and stout, as are also the toes, which are furnished with strong acute claws.

These birds are for the most part inhabitants of the Eastern Hemisphere, in the warmer regions of which they are tolerably abundant; only one genus (*Sturnella*) is found in America.

The only species generally distributed and permanently resident in Europe is the common Starling (*Sturnus vulgaris*); a second species, the *Sturnus unicolor*, appears to be peculiar to Sardinia; and a third, the Rose-coloured Pastor (*Pastor roseus*), which inhabits the warmer parts of Asia and Africa, is a regular visitor of some parts of the continent of Europe, and stragglers have occurred in the British Isles.

The common Starling (*Sturnus vulgaris*) is a well-known, handsome, and sprightly bird, which is very generally distributed in this country, living in flocks during the greater part of the year, and separating only during the breeding season. The Starling builds in the holes of rocks and buildings, or in hollow trees. The nest is composed of twigs, straws, dry grass, and roots; the eggs are four in number, and of a delicate pale blue tint. When the young are hatched, both parents attend to their wants with the utmost care, and as soon as they are able to leave the nest, the whole family join company with others of the same species, usually forming large flocks, which feed and roost in society. Numerous flocks appear often to seek the same roosting-place night after night, and the numbers which frequent some favourite spot for this purpose, are sometimes astonishing. Mr. Yarrell states, that during summer and autumn, the birds roost by thousands amongst the reeds in the fenny districts, often crushing the plants down to the water's edge in large patches, like grain after a storm. The same author gives two other instances of enormous multitudes of these birds resorting constantly to particular spots. One of these localities is an evergreen plantation of Arbutus, Laurustinus, &c., covering some acres, to which the birds repair every evening almost by "millions," according to Mr. Yarrell's informant, from the low grounds about the Severn. The evergreens are completely stripped of their leaves, and the Pheasants, for whose benefit the plantation was intended, have been driven quite away from the ground. The noise and stench of the birds are described as something unbearable, and even during their absence in the day time, the odour of the place is exceedingly disagreeable. The other roosting-place mentioned by Mr. Yarrell, is a mass of thorn trees in the Zoological Gardens at Dublin, in which according to Mr. Ball, from one hundred and fifty to two hundred thousand Starlings sleep every night from the end of October to the end of March. During the winter the Starlings frequently roost in Pigeon-houses, and, according to some observers, they sometimes perform a sort of migration in severe winters, passing in large flocks into the mild regions of the south-west of England, the counties of Devon and Cornwall.

The Starling feeds principally upon worms, insects, and snails, but also frequently upon fruits of different kinds, in search of which it often frequents gardens. In hard winters it is said to visit the coast in search of marine animals, which it finds by turning over the stones with a jerk, immediately seizing whatever may be underneath. This bird appears to be very generally distributed over the whole of the Eastern Hemisphere. In the north it extends to Scandinavia and the Faroe Islands; and in the south, to the Cape of Good Hope. It is found in China and Japan, at the eastern extremity of Asia, and in the small islands of the Western Ocean. In many of the countries where it occurs, it is regarded with considerable favour, and in England and elsewhere it is frequently domesticated, as it possesses much of the sagacity of the Crows, and may be taught to whistle tunes, and even to repeat a few words. A fine male Starling is an [illegible]ly handsome bird; his plumage is black, tinged with metallic purple and green, [illegible] spotted with buff. The female is far less brilliant.

The Rose-coloured Pastor (*Pastor roseus*), which is generally distributed in the warmer parts of Asia and Africa, is also of common occurrence in the south of Europe, especially in Russia; in the western parts of the continent of Europe it is rare, and only a few individuals are recorded as having reached this country. It is a beautiful bird; the head and neck, the quill feathers of the wings and tail, and the extremities of the tibiæ are black, with a violet gloss, the feathers of the top of the head being elongated so as to produce a sort of crest; the rest of the plumage is of a delicate rose-colour, and the legs and bill are yellowish. Like the common Starlings, these birds associate in large flocks, and feed to a great extent upon grain. They are also great destroyers of insects, and in some places are regarded almost as sacred, from their devouring great quantities of locusts. Like the Starling also, they have a great predilection for the company of cattle and sheep, constantly walking about in their neighbourhood, and often mounting on their backs to search for insects amongst their hair.

A nearly allied species, the *Pastor tristis*, which closely resembles the preceding in its habits, is still more celebrated as an enemy to locusts of all kinds. It was transported from the Philippine Islands to the Mauritius, in order to rid that island of the locusts by which it was overrun, and has increased so rapidly under the protection of the government that, according to Bory de Saint Vincent, it has completely "ruined" the entomology of the island.

The *Sturnella ludoviciana* of North America, sometimes known under the name of the *Meadow Lark*, is very generally distributed over the whole of that continent, from Upper Canada to New Orleans and Florida. It is about two inches longer than our British species, which it appears to resemble in its general habits, although it differs materially in the position which it selects for its nest, this, according to Wilson, being "generally built in, or below, a thick tuft or tussock of grass." The nest is composed of dry grass, lined with fine bent, and has an arched entrance level with the ground. Its food consists of insects and seeds; and its note is said by Wilson to be surpassed by that of none of the American warblers in sweetness and tenderness of expression. They are constantly brought to market in some parts of the United States, and their flesh is considered equal in delicacy to that of the American Quail. Its plumage is very beautiful, being principally variegated with yellow and black.

The remainder of the Sturnidæ are all inhabitants of America. They form two sub-families. The birds composing one of these, the *Quiscalinæ*, are distinguished by the curious form of their tails, which are long and graduated, with the sides curved

upwards, whence the name of *Boat-tails* has been given to them. They have a long, straight bill, with the nostrils placed in triangular grooves on each side of the base; the wings are pointed, and the hind toe is long and armed with a strong curved claw. From the interior of the upper mandible a sharp bony process descends into the mouth, which has been compared to the broken blade of a pen-knife: its use is probably to assist in breaking up the food.

These birds are found both in North and South America, where they live in troops like the Starlings, and feed upon worms, insects, and seeds. They often commit extensive depredations upon the grain fields in the United States, where two species, the *Quiscalus ferrugineus* and *Q. versicolor* occur in great abundance. They migrate from south to north in the spring, returning again to their winter quarters in the autumn; and on their first arrival in the more northern states, which takes place in the month of March, they feed principally on worms, insects, and grubs, "of which," says Wilson, "they destroy prodigious numbers, as if to recompense the husbandman beforehand for the havoc they intend to make among his crops of Indian corn." Their attention to this valuable plant commences with its first appearance above the ground, which, according to the distinguished ornithologist just quoted, is hailed by the birds with screams of peculiar satisfaction; they immediately descend upon the fields, and pull up and devour the seed, scattering the young green blades in every direction. They return again to the charge about the beginning of August, when the young ears are in their milky state, a period which appears to be selected by most of the feathered enemies of the Indian corn for their most violent attacks upon it. With the greatest dexterity they strip off the voluminous outer covering of the ear, and leave nothing behind that can be of the least use to the farmer. So extensive is the injury thus done to the crops, that, as Wilson tells us, the farmers of some parts of the United States generally allow one-fourth to the Blackbirds, amongst which the *Quiscalus versicolor* plays a most important part. Late in the autumn these birds collect into immense flocks, and wing their way to the warm Southern States, where they pass the winter, congregated together in vast multitudes. Wilson describes his coming upon one of these "armies of Grakles," as he calls them. He says, "they rose from the surrounding fields with a noise like thunder, and, descending on the length of road before me, covered it and the fences completely with black; and when they again rose, and after a few evolutions descended on the skirts of the high-timbered woods, at that time (January) destitute of leaves, they produced a most singular and striking effect: the whole trees, for a considerable extent, from the top to the lowest branches, seeming as if hung in mourning: their notes and screaming the meanwhile resembling the distant sound of a great cataract."

The *Quiscalus versicolor*, which is the commonest of the North American species, is called the *Crow-Blackbird* by the farmers of the United States. It is about twelve inches in length, and entirely of a black colour; but its plumage, in certain lights, reflects beautiful blue, violet, and coppery tints, which has caused Wilson to give it the name of the Purple Grakle. It nestles in society, usually a pine and cedar trees. The nest is composed of mud, with stems and roots of grass, and lined with fine bent and horse-hair. The female, which is of different shades of brown, lays five eggs, of a bluish-olive colour, with dark streaks and spots. In captivity it is readily tamed; and, like the European Starling may be taught to repeat a few words. The *Q. ferrugineus* is smaller, measuring only about nine inches in length; the male is greenish-black, and the female, as in the larger species, brownish.

The *Icterinæ* form a second group of American Starlings, which, like the preceding, have a nearly straight bill. The tail is elongated, and usually wedge-shaped, and the wings long and pointed; the tarsi are not longer than the middle toe, and the toes are of moderate size and strength. The bill is acute at the tip. The majority of these birds are found in tropical America, but several species are found in the northern division of that continent. They resemble the Starlings in their gregarious habits, whence the name of *troupiale* applied to them by the French, which has been modified into *troopial* by the English. Most of them build pendulous nests, and the process by which the Baltimore Oriole (*Yphantes Baltimore*) constructs its pouch-like nest is thus described by Wilson. Few of the Orioles, he says, "equal the Baltimore in the construction of these receptacles for their young, and in giving them, in such a superior degree, convenience, warmth, and security For these purposes he generally fixes on the high, bending extremities of the branches, fastening strong strings of hemp or flax round two forked twigs, corresponding to the intended width of the nest; with the same materials mixed with quantities of loose tow, he interweaves or fabricates a strong firm kind of cloth, not unlike the fabric of a hat in its raw state, forming it into a pouch of six or seven inches in depth, lining it substantially with various soft substances, well interwoven with the outward netting, and lastly, finishes with a layer of horse-hair; the whole being shaded from the sun and rain by a natural pent-house or canopy of leaves." Sometimes the opening, which is at the top of the nest, is partly closed by a horizontal cover. Although the nest of the Baltimore Oriole is usually composed of the materials mentioned above, he is by no means particular about appropriating any article which appears to him to be applicable to his purpose, and during the breeding season, thread put out to bleach, or skeins of silk, if not taken care of, will frequently find their way into the dwelling of this ingenious little architect.

In many cases, the birds of this sub-family will build, or rather weave, their nests in societies of considerable number upon the same tree. No less than forty-five nests of two species, the *Cacicus icteronotus* and *hæmorrhous*, were seen by Mr. Edwards during his voyage up the Amazon, in one small tree; the nests were nearly two feet in length, with an opening near the top, and were woven with grass, often depending from one another, and so completely concealing the tree, that only a few of the uppermost leaves were visible. The Orchard Oriole of the United States (*Icterus spurius*), also weaves its nest of grass; this bird sometimes chooses the weeping willow to build on, taking several twigs of the tree into its fabric, which is then concealed by the leaves.

It is remarkable that, in a group distinguished for the ingenuity displayed in the construction of the nests, one species should be found which, like the Cuckoos, deposits its eggs in the nests of other birds, and leaves the business of incubation and the care of the young to strange foster parents. This is the Cow-pen bird (*Molothrus pecoris*), which is also a native of the United States, and receives its name from its constant practice of associating itself with cattle, apparently for the sake of the insects, seeds, &c., which they can pick up amongst the dung and litter of the yards. As in the case of the Cuckoo, the young of this bird is always found singly in the nest; but it is not known whether it resorts to the same practice as the young Cuckoo to get rid of its unfortunate foster-brothers, or of the eggs which should have produced them; for it is a singular fact, that the egg of this parasite requires a day or two less to hatch than those of the birds in whose nests it is usually deposited.

All these birds appear to be of a migratory disposition; and those which occur in

the United States regularly pass the winter in the warm regions of the south, and proceed to the northern states in the spring. As they come in vast flocks, and share with the Purple Grakle, already referred to, in its fondness for grain of all kinds, especially Indian corn in the milky state, they are regarded with no great favour by the American farmers; and one species especially, the Red-winged Starling (*Agelaius phœniceus*), is celebrated for the havoc it makes in the grain-fields. The males of most of the species are adorned with exceedingly brilliant colours,—orange, scarlet, and black being the prevailing tints. One of the commonest species, the Baltimore Oriole, which derives its name from the circumstance that its colours, black and orange, were those of the livery of Lord Baltimore, formerly proprietary of Maryland, has received the name of *fire-bird*, from the fiery effect of the bright orange when seen dashing through the trees. It is also called the Golden Robin. The females are far more sober in their tints.

The great group of Conirostral birds is concluded by the vast family of the Finches, or *Fringillidæ*, a group of birds which includes an immense number of species, exhibiting a great variety of structure and habit. They are characterized by having a short, stout, conical bill, with an acute tip, of which the upper mandible has no notch at the extremity. The tongue is rather fleshy, with the tip horny and usually more or less slit. The œsophagus forms a small crop, and the stomach a powerful gizzard, indicating, with the peculiar form of the bill, that the food of the birds consists principally of grain. The tarsi are compressed and slender, usually covered in front with seven scutella (Fig. 210), but sometimes with a single shield, and the toes are of moderate length, armed with long curved claws, that of the hinder toe being often longer than the rest. The wings

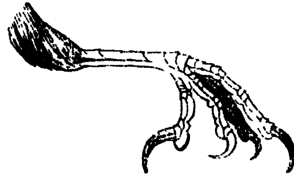


Fig. 210.—Foot of a Finch.

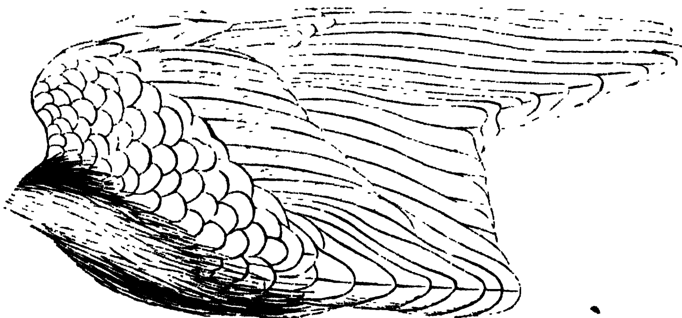


Fig. 211.—Wing of the Chaffinch (*Fringilla cælebs*).

are rather short and somewhat pointed at the extremity (Fig. 211), and the tail is composed of twelve feathers.

These birds are active on the wing, their flight being usually effected by a series of jerks or undulations. On the ground they generally progress by hopping with both legs at once. They always pair, and their nests are usually beautifully constructed; some of them, in fact, are most elaborate and elegant fabrics.

The multitude of species included in this family has given rise to numerous subdivisions, and Mr. G. R. Gray divides the Fringillidæ into no less than nine sub-families. The first of these, that of the *Ploceinæ*, or Weaver-birds, includes some of the most ingenious of feathered architects. These birds have a strong conical bill, with the base of the ridge projecting upon the forehead; the wings are rounded, with the first quill very short; and the legs and feet are robust, with the hind toe nearly as long as the middle one.

The majority of these small birds are inhabitants of Africa, but a few species are found in India and the islands of the Eastern Archipelago. Their food consists of insects and seeds, and the species of the genus *Textor* accompany the Buffaloes and perch on their backs for the purpose of picking off the parasitic insects which infest them.

Some species of this group, forming the genus *Vidua*, are remarkable for the great development of some of the tail coverts in the male (Fig. 212), which often considerably exceed the body in length; these beautiful plumes, which lend so much grace to the appearance of the bird, only exist, however, during the breeding season, and when this is over fall off, the males being then scarcely distinguishable from their partners. These birds are found in Western Africa, and appear to be especially abundant in the kingdom of Whydah, whence the name of Whydah birds, or Finches, commonly applied to them; this name has, however, become corrupted into Widow-birds. The French call them *veuves*, or widows, and the generic name *Vidua* has the same meaning.



Fig. 212.—Angola Whydah-bird (*Vidua paradisea*).

The nests of the Weaver-birds are composed of grass and other fibrous vegetable matters, beautifully interlaced or woven together, and usually suspended at the extremity of a slender twig or palm-leaf, so as to be beyond the reach of the monkeys and other enemies, who would plunder it of its eggs. The nest usually consists of a sort of pouch in which the business of incubation is carried on, from one side of which a tubular appendage of variable length is continued downwards. The entrance to the nest is by an aperture at the bottom of this, so that the eggs and young are most efficiently sheltered from all their enemies. Some of the species attach their nest each year to the bottom of the one they occupied the year preceding, and Sonnerat states that he has seen five nests of an Eastern species, the *Ploceus pensilis*, placed in this manner below each other.

The most remarkable nest, however, is that made by the Social or Republican Grosbeak (*Philæterus socius*), a bird about the size of the Bullfinch, and of a reddish-brown colour, which inhabits the interior of South Africa. The structure of this

nest is so singular in its construction, that a somewhat detailed account of it will not be out of place. The birds live together in large societies, inhabiting large common nests,* built upon the mimosa tree, which appears to be particularly adapted for this purpose, as the smoothness of its trunk will prevent many noxious animals from reaching the nests. The nests are composed of a fine species of grass closely woven together, and so arranged that from eight hundred to a thousand nests are supposed to be sometimes supported upon a single tree, and covered with a large roof. Round the edge there are numerous entrances, each of which is continuous with a sort of passage, and on each side of this are the nests, placed, according to Paterson, about two inches apart. It is probable that, as the colony increases in number, they continue adding to the common nest, until at length the weight becomes so great that the tree gives way under it, and the birds are then compelled to seek other situations in which to found fresh colonies.

Nearly allied to the preceding, and perhaps uniting these with the true Finches, is the sub-family of the Grosbeaks (*Coccothraustinæ*). In these birds the bill is very large, broad, and thick, with the mandibles nearly equal: the wings are rather long and pointed; the tail short; the feet and legs stout and strongly scaled, the tarsi not longer than the middle toe and the hinder toe rather shorter than the inner one. In the common European Grosbeak (*Coccothraustes vulgaris*, Fig 213) some of the quill feathers of the wing exhibit a remarkable conformation (Fig. 214). Five of the secondary quills and the two innermost primaries are truncated at the end, as though they had been clipped straight, and the four following primaries, proceeding towards the outer edge of the wing are broad, and notched at the extremity, with the outer angle turned outwards.

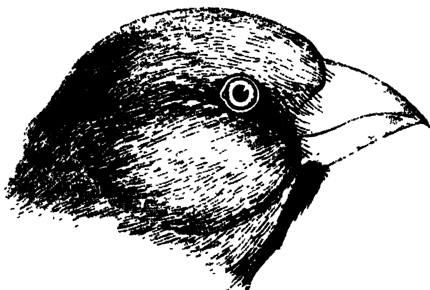


Fig. 213.—Head of the Common Grosbeak, or Hawfinch (*Coccothraustes vulgaris.*)

These birds generally inhabit the woods of mountainous countries, and appear to be very shy in their nature. They feed upon seeds and fruits, and are exceedingly fond of the kernels of stone fruit, which their powerful bills enable them to crack with great facility. The only British species is the Common Grosbeak (*Coccothraustes*

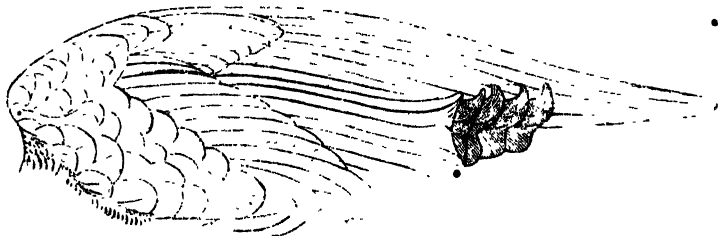


Fig. 214.—Wing of the Common Grosbeak.

*vulgaris*), or Hawfinch, as it is frequently called, a bird which is very common in some parts of the continent of Europe, but was long supposed to be only an occasional winter visitor to our islands. It appears, however, that the bird really resides permanently and breeds in this country, and it is probably owing to its extreme shyness that it was so long considered a rare British bird. According to Mr. H. Doubleday, it is abundant in Epping Forest, where it feeds principally on the seeds of the Hornbeam, but also exercises its powerful bill on the "kernels of haws, plum stones, laurel berries, &c., and in summer makes great havoc amongst green peas in gardens." Temminck says that on the continent it feeds principally on the seeds of the plane tree, pine, and cherry. The last named ornithologist states that its nest is elaborately constructed, and placed on the highest branches of the trees; but from Mr. Doubleday's observations, it appears that the birds prefer a whitethorn bush to any other situation, although they frequently build in oaks, hornbeams, hollies and fir trees. The nest is composed of dead twigs of various trees and shrubs, mixed with pieces of gray lichen. The latter material occurs in greater or less quantities in all the nests. They are lined with fine roots and hair. The eggs are from five to six in number, of a pale olive green colour, spotted with black. The bird is about seven inches in length, and in form has a good deal of resemblance to a stout built Sparrow. Its colours are different shades of brown and gray, variegated with black and white, and notwithstanding the sobriety of its tints, it must be regarded as a handsome bird.

The other species of this group are generally distributed in both hemispheres. Many of them are beautiful birds, and some are celebrated as fine songsters. One of the finest species is the Cardinal Grosbeak (*Cardinalis virginianus*), a common North American species, the general colour of the male of which is a fine bright red. The head of this bird is also adorned with a pointed crest, which it can raise at pleasure into a perpendicular position, and which gives it an air of great sprightliness. It is about an inch longer than the European species.

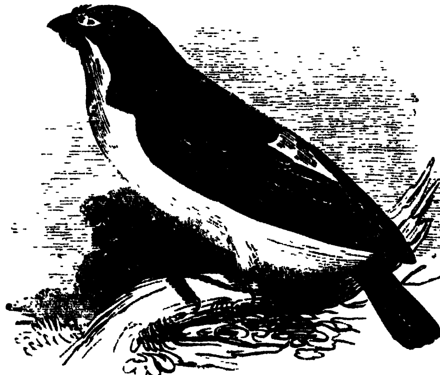
Some singular little birds belonging to this group were discovered in the Galapagos Islands by Mr. Darwin, and have been described by Mr. Gould under the generic name of *Geospiza*. Unlike the rest of the group, these birds seek their food upon the ground, frequenting, according to Mr. Darwin, "the rocky and extremely arid parts of the land, sparingly covered with almost naked bushes, near the coasts; for here they find, by scratching in the cindery soil with their powerful beaks and claws, the seeds of grasses and other plants, which rapidly spring up during the short rainy season, and as rapidly disappear." They dig up roots and seeds from a depth of six inches in the soil, and are in consequence very destructive to vegetation. During the dry season they often eat portions of a cactus, the *Opuntia Galapageia*, which grows in those islands, probably for the sake of the moisture which it contains. Two or three other nearly allied genera are found in the Galapagos group; but one of these (*Cactornis*) is strikingly distinguished from *Geospiza* by the form of its bill, which, instead of being very short and thick, as in the latter genus, is considerably elongated, and bears some resemblance to that of a Starling. The species *Cactornis scandens*, as its name implies, climbs about upon the cactus above referred to, the fruit of which constitutes a great part of its food; but it also descends to the ground, and searches for seeds in the manner of the *Geospiza*.

The third sub-family of the Fringillidæ is that of the *Tanagrinæ*, or Tanagers, a group of splendidly-coloured birds which are peculiar to America, and almost entirely confined to the southern division of that continent. The Tanagers are distinguished

from the Finches in general by the possession of notches in the upper mandible, a character which induced Cuvier and several other naturalists to place them amongst the Dentirostral birds. The bill in these birds is usually triangular at the base, with the ridge of the upper mandible more or less arched; the wings are rather short and pointed, and the feet short and slender. The hind toe is elongated and strong, and all the toes are armed with stout, curved claws. The tarsi are usually covered with transverse scales; but in some cases these give place to a single long plate, which occupies nearly the whole length of the tarsus.

These beautiful little birds, as already stated, are principally found in the warmer regions of South America. Of 222 species which Mr. Sclater refers to the group, 193 belong to the South American continent; and the remainder, with but few exceptions, are from Central America and the southern parts of Mexico. A few species are found in the West Indian Islands, and three are summer visitors to the United States.

The Tanagers feed upon fruits and insects, and usually collect in considerable troops. Their nests are built upon the branches of trees, and are usually of a rather slight texture. In the hot climates they are said to produce two broods in the year, but the species which visit North America appear only to breed once.


Fig. 215.—Organist Tanager (*Euphonia musica*).

Most of these birds have a pleasing song, and some of them are remarkable for their musical powers; the genus *Euphonia* receives its name from this circumstance. The typical species of this genus, the *Euphonia musica*, or Organist Tanager, is a native of the West Indies; it is about four inches in length, and the plumage of the male is beautifully varied with black and orange. Orange, scarlet, and black are in fact prevalent colours in this group of birds, and their appearance amongst the trees of their native woods is said to be exceedingly brilliant.

We now come to the sub-family of the *Fringillinæ*, or True Finches, a most extensive and generally distributed group of birds, many of which are distinguished for the beauty of their plumage, whilst others are amongst our most esteemed singing birds. These birds have usually a short, conical bill, which is broad at the base and gradually slopes to the extremity; the upper mandible is very rarely notched. The wings are elongated and pointed; the tail variable in length and form; the toes and tarsi slender, the latter being about the same length as the middle toe, and the former generally armed with long, curved, and acute claws.

When the breeding season is over, these birds usually collect into large flocks and fly in company in search of food. This consists principally of the seeds of various plants, and some of the species will also attack fruit. During the breeding season they capture great numbers of insects for the nourishment of their young, but at other times

appear to pay but little attention to this description of food. Most of them are remarkable for the neatness and warmth of their nests.

Of this group we have several well-known British species, some of which are permanently resident with us, whilst others only visit us at particular seasons. Of the former, the Sparrow (*Passer domesticus*) is a familiar example, and others, almost equally so, are the Chaffinch (*Fringilla cælebs*), the Linnet (*Linota cannabina*), and the Goldfinch (*Carduelis elegans*). The last named species (Fig. 216) is undoubtedly the

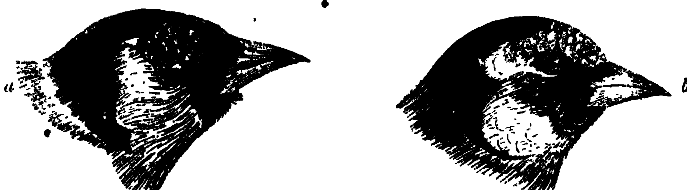



Fig. 216.—Head of the Goldfinch (*Carduelis elegans*). *a*, male; *b*, female.

gayest in his apparel of all our small native birds, and as his song is exceedingly sweet and very charmingly modulated, he is a great favourite with most people. The Goldfinch feeds upon the seeds of various plants, but is especially fond of those of the different kinds of Thistle, and wherever these plants have been allowed to ripen their seeds in any quantity, the Goldfinch may be seen clinging to the stalks in every position, like a tiny Parrot, picking out the little seed-vessels, and scattering their downy plumes to the wind. It is very generally distributed in this country, and is also found in all parts of Europe. The nest is remarkably neat and round; it is formed of moss, slender twigs, grass, and roots, and usually lined with wool, the down of plants, and hairs. Its ordinary position is in a tall bush or a hedge, but the bird often builds in apple or pear trees in orchards. The eggs are four or five in number, and very delicate in their appearance. Their colour is a pale bluish-white, spotted with purple and brown.

The Linnet, so called from its partiality for the seeds of flax, is another very beautiful song bird, although in its plumage it is far more sober than the Goldfinch. Nevertheless, during the breeding season, the male Linnet acquires a red tinge on the breast and crown of the head. These birds appear to prefer commons and places overgrown with furze, and it is usually under the protection of the formidable spines of this plant that they build their nests and bring up their young.

The Chaffinch (*Fringilla cælebs*) is a handsome bird, almost equalling the Goldfinch in the elegance and sprightliness of his appearance; and, although his song is far inferior to that of the two species above referred to, yet, from its being an indication of the approach of spring, it is heard with pleasure by most people: and the bird is in fact a favourite with everyone except the gardeners, for whose radish-seed he entertains a most extraordinary predilection.

The two or three species of Finches which regularly visit this country, all come to us to pass the winter. A few individuals, indeed, usually remain through the summer and breed here; but the greater part of them quit us in the spring for their breeding-grounds in the north of Europe. The best known species is the Lesser Redpole (*Linota linaria*, Fig. 217), which is taken in great abundance by the bird-catchers in the latter part of the autumn. It is the smallest of the British species of

this group, and is a handsome, lively, little bird. It arrives in this country about the end of September, and remains here until April.

Of the exotic species, the best known is the common Canary bird (*Carduelis canaria*), a native of the Canary Islands, where, and in Madeira, it is still found wild. The wild bird is very different in appearance from the domesticated varieties with which we are familiar, being of a grayish colour; but it is said by Dr. Heinekin to be a beautiful songster. Like the other Finches, it builds a nest with roots, moss, and feathers, usually in tall bushes and trees; it lays from four to six eggs, and is said to breed five or six times in the season.

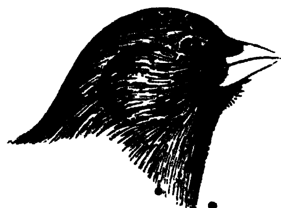


Fig. 217.—Head of the Lesser Redpole (*Linota Linaria*).

This favourite cage-bird was introduced into Europe in the sixteenth century, and has since always been highly prized. It is now bred in great quantities in large establishments in Germany, whence the greater part of Europe is supplied with Canary birds.

Several other exotic species are also brought to this country. Of these, the commonest are the Amadavade (*Fringilla amandava*), and the Rice bird or Java Sparrow (*Oryzornis oryzivora*). The former is a very small bird, scarcely four inches in length, of a brownish colour above, paler beneath, and spotted with white; the rump is red, and the quill feathers of the tail and wings black. The bill is also of a fine red colour. This elegant little bird is common in most parts of southern Asia, whence it is imported into Europe in great quantities. The Java Sparrow is a considerably larger bird than the preceding, and of a delicate bluish colour, with the top of the head black, the cheeks and the bill red. It is a native of Java and other parts of Asia, where it appears to be exceedingly abundant; it feeds to a great extent on rice.

The *Emberizinæ*, or Buntings, approach very closely to the Finches. They have a conical, acute bill, with the ridge of the upper mandible nearly straight, and its margins sinuated and inflected, or turned in. The palate is furnished with a knob; the wings are of moderate size; the tarsi are about equal in length to the middle toe; the hind toe is longer than the inner one, and the claws are slender. These birds are very generally distributed in both hemispheres. They are more terrestrial in their habits than the Fringillinæ, generally feeding on the ground, and building their nests either in low bushes or in tufts of grass. Like the Finches, they collect into large flocks in the winter, and frequent the open fields. Their food consists of seeds and insects; in the course of the autumn they pick up large quantities of grain in the stubble fields, and become quite fat, when some of the species are regarded as great delicacies. One of these is the Ortolan (*Emberiza hortulana*), a very abundant bird

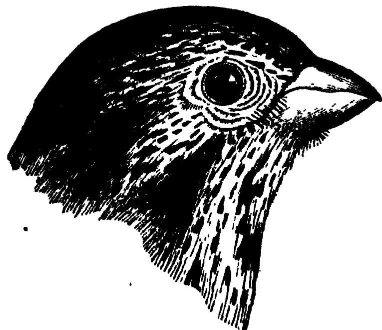


Fig. 218.—Head of the Corn Bunting (*Emberiza miliaria*).

in the South of Europe, where they are caught in great numbers at the commencement of autumn, and fattened for the table upon oats and millet seed. To facilitate the process of fattening they are kept in a dark room. The Ortolan occurs occasionally in Britain, with five other species of the genus *Emberiza;* and two species of *Plectrophanes*, or Lark-Buntings, also make their appearance here in the winter, but breed in the colder regions of both Europe and America.

The *Alaudinæ*, or Larks, are distinguished from all the other Fringillidæ by the great length and straightness of the claw of the hind toe—a character which they possess in common with the Pipits (*Anthus*) amongst the Dentirostres. The bill is rather short and conical; the upper mandible is not notched at the tip, and the wings exhibit a remarkable character,—the tertiary quills are much elongated, usually as long as the primaries (Fig. 220).

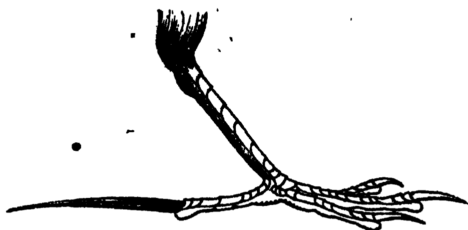


Fig. 219.—Foot of the Sky-lark (*Alauda arvensis*).

The position of these well-known birds is indeed somewhat problematical, as they exhibit a combination of the characters of several very distinct groups of birds. Thus the *Pyrrhulaudæ*, or Finch-larks, appear to lead directly to the true Finches, and the genus *Plectrophanes*, amongst the Buntings, also serve to connect the Larks with the other members of the present family; whilst, on the other hand, the Pipits agree so closely with them in the size and form of the hinder claw, and the great development of the tertiary quills, that they appear almost to form a single group. But the Pipits are evidently allied to the *Motacillæ*, which are Dentirostral Birds. On the whole, it seems as though these birds stood on the confines of the two groups, with their affinities about equally balanced.



Fig. 220.—Wing of the Sky-lark.

The Larks are generally distributed throughout the Eastern Hemisphere, and one species also occurs in North America. They generally frequent open places, especially meadows, where they run upon the ground in search of the seeds, worms, and insects upon which they feed. They never hop like the other members of the family. Their flight is rapid and undulating; but some of them also have the habit of rising perpendicularly to a great height in the air, singing the whole time. They make their nests on the ground, and produce from four to six spotted eggs. There is a great sameness in their colouring, which usually consists of shades of gray and brown, often assimilating closely to the soil upon which the birds live.

Five species have been found in Britain. Of these the most familiar is the Sky-lark (*Alauda arvensis*, Fig. 221), which is also known as the Field-lark, from its constantly inhabiting meadows and corn-fields. It begins to sing early in the spring, and continues its song until late in the autumn, generally singing whilst rising or falling perpendicularly in the air, although his joyous notes are occasionally poured forth

whilst sitting on the ground. So powerful is the voice lodged in this little body, that its sound may be heard long after the songster is quite out of sight; and even then a practised ear can distinguish those peculiarities in the song which mark whether the bird is still rising, or stationary, or gradually descending. The Lark sings for about eight months in the year, and as his notes are remarkable for their power and vivacity, he is a great favourite as a cage-bird. In the summer his song commences before three o'clock in the morning, and continues till after sunset. He is also very long-lived, and thrives well in confinement, notwithstanding a commonly received notion that his perpetual fluttering against the bars of the cage is a sign of regret at the loss of his liberty. Mr. Yarrell mentions an instance of one of these birds living in a cage for nineteen years and a half.



Fig. 221.—Head of the Sky-lark (*Alauda arvensis*).

The nest of the Sky-lark is placed on the ground, often under the shelter of a clod or tuft of grass. It is composed of different grasses. The birds usually pair in April, and produce two broods in the course of the summer. During the winter they assemble in large flocks, and are then often taken in great numbers by dragging a net over them when they have taken shelter in the stubble and herbage.



Fig. 222.—Head of the Wood-lark (*Alauda arborea*).

Of the other British species one, the Wood-lark (*Alauda arborea*, Fig. 222), is pretty generally distributed in the country, although by no means so common as the Sky-lark. It is found principally in fields which are interspersed with woods, copses, and hedges, and, unlike the Sky-lark, frequently perches upon trees, and sings in that situation. Its nest is usually made under the shelter of a bush; it is composed of coarse grass and moss, lined with fine bents and hairs. Its note is greatly admired.

The Shore-lark (*Otocoris alpestris*) is rare in Britain; it is the only species of the group found in America, in the northern parts of which continent it breeds during the summer months, proceeding southwards in the winter, sometimes as far as Virginia and Carolina. It breeds on the rocky coasts of Labrador, and on the shores of the Arctic Sea. In Labrador, the nest is made upon a patch of lichen, which the bird resembles so closely in its tint, that when sitting, she will remain, trusting to this for concealment, until the intruder's foot is almost upon her. When danger approaches very near, however, the bird immediately flutters away, feigning lameness with so much art, that one unaccustomed to the habits of the species would infallibly be deceived. The other two species are of exceedingly rare occurrence.

The *Pyrrhulinæ*, or Bullfinches, forming the next sub-family, greatly resemble the Grosbeaks in many of their characters, especially in the large size of the head, and the

stoutness of the bill (Fig. 223), which is compressed, with the ridge of the upper mandible convex. The wings are rounded, the tarsi short, and the lateral toes are usually unequal.

The Bullfinches are principally inhabitants of the temperate regions of the world, very few species being found between the tropics. They occur in both hemispheres, and feed principally upon seeds, the hardest envelopes of which are unable to resist the action of their powerful bills. They also devour berries of various kinds, and in the spring the Common Bullfinch (*Pyrrhula vulgaris*) is exceedingly destructive in gardens, from its attacking the flower-buds of fruit trees, frequently to such an extent as to ruin the whole crop. They generally live in wooded districts.



Fig. 223.—Head of the Bullfinch (*Pyrrhula vulgaris*).

The Common Bullfinch is a well-known British species,* which is often kept in confinement principally on account of its liveliness, and the beauty of its plumage. The male has the top of the head, the wings, and the tail, black; the back grayish, with the rump white; and the lower surface bright red. The back in the female is brownish, and the lower parts yellowish-brown. The Bullfinch is an abundantly distributed bird in this country, where it inhabits small woods, plantations, hedgerows, and orchards, especially in cultivated districts. It builds its nest, which is composed of small, dry twigs, and lined with fine roots, at a height of four or five feet from the ground, either in a bush or on the branch of a fir tree; its eggs are four or five in number, of a pale blue colour, spotted with purple and brown. It breeds in May.

The natural voice of the Bullfinch has nothing to recommend it, although some of its notes are said to be soft and plaintive. It is remarkable, however, for its excellent memory, which enables it to retain tunes which have been played or whistled to it for some time. To receive this instruction young birds taken from the nest are the best, and the course of teaching usually lasts for about nine months, as with a shorter period of instruction the birds are liable to get their lessons imperfectly. The airs are generally played to them either with a flageolet or a small bird-organ, and the best time for giving them their lesson is said to be soon after they have been fed, as, according to Bechstein, they are particularly attentive whilst digestion is going on. With all this care the birds often lose the whole or part of their song during their first moult, so that it is no wonder that a good piping Bullfinch frequently fetches a considerable sum. Most of them are trained in Germany, and great numbers are imported into England from that country.

Another species, of which a few specimens have been shot in this country, is the Pine Grosbeak, or Pine Bullfinch (*Pinicola enucleator*), which is an exceedingly abundant bird in the Arctic portions of both continents, but appears to be only a rare visitor to the more temperate regions of Europe, although in America it performs pretty regular migrations from the Arctic regions, where it breeds during the summer, to the northern and middle parts of the United States. It is considerably larger than our common Bullfinch, measuring between eight and nine inches in length, but resembles it closely in its general form, although the colours are very different. The head, the neck, the fore part of the breast and the rump are all of a bright red colour; the back is grayish-brown or black, with the feathers edged with red, and the

lower parts are light gray. The wings and tail are dusky, but many of the feathers in the former are tipped and margined with white, so as to produce two more or less distinct white bands. In its habits the Pine Grosbeak closely resembles the common Bullfinch, and its food appears to be of the same nature. In its Arctic residence it is said to feed principally on the buds of the birch-willow. In the more temperate regions which it visits, it generally haunts the Pine forests, and is rarely met with in any place where these do not exist. In Russia it is said to be taken and brought to market in great quantities, as its flesh is considered very good. It is also described as a very agreeable songster. Several other species are found in the northern parts of both hemispheres, but the habits of all are very similar.

The *Loxinæ*, or Crossbills, are also very similar to the preceding, but are distinguished by the peculiar structure of the bill, which is considerably longer than in the Bullfinches, and compressed towards the tip, where the mandibles are more or less hooked and crossed (Figs. 224 and 225). Like the Bullfinches and Grosbeaks, these




Figs. 224 and 225.—Head of the Common Crossbill (*Loxia curvirostra*). *a*, from above; *b*, from the side.

are very stout birds, with large heads and strong bills; they are generally distributed over the northern parts of both hemispheres, especially in the forests of pines, the seeds of these trees constituting their principal food. For the extraction of the seeds from the hard woody cones of the different species of pines, the bills of these birds appear to be particularly adapted; and the ease and rapidity with which they perform this operation are said to be astonishing. They do not, however, confine themselves strictly to this food, but will often eat the seeds of other trees; and, according to some observers, they frequently visit orchards and destroy great numbers of apples, with the view of getting at the seeds. The birds are said to split the apples with one or two blows of the bill.

Three species have occurred in the British islands—the Common Crossbill (*Loxia curvirostra*, Figs. 224, 225), the Parrot Crossbill (*Loxia pityopsittacus*), and the White-winged Crossbill (*Loxia leucoptera*). The first of these is the commonest species all over Europe, as also in this country, which, however, it seems to visit at very irregular periods, occasionally occurring in great quantities for a time, and then almost entirely ceasing its visits for some years. In this country it appears to breed very rarely; the nest is composed of grass and twigs, lined with finer grass and a few hairs, and is usually placed near the top of a pine tree. The actions of the bird, both in a state of nature and in confinement, are very Parrot-like, as it constantly climbs about with

the assistance of its hooked mandibles. The true object of the peculiar arrangement of these organs is, however, to enable the bird to get at its common food with ease, and for this purpose they are admirably adapted. Buffon indeed, with his customary flippancy in disposing of anything for which he could not immediately account, describes the formation of the bill in the Crossbill as a defect, or *error* of nature, saying that from the curvature and obliquity of the mandibles the bird is incapable of bringing the two points in contact so as to pick up seeds, and that it is consequently obliged to take all its food at the side of the bill. It appears, however, from the observations of other naturalists who have trusted less to their imagination, that the bill of this bird exhibits in its structure a wonderful adaptation to its peculiar mode of obtaining its food, and that so far from being a defect it is in reality a perfection. According to Townson, who was one of the first to contradict Buffon's assertions, the bird insinuates its bill between the scales of the fir cones, and then by a lateral action of the lower jaw forces these asunder, when, by bringing the points of the mandibles immediately over each other, it can pick out the seed in the same manner as if the bill had the usual form. He adds, that the lateral force of the lower mandible is surprising, and that when he gave almonds in the shell to some which he kept in confinement, they first picked a hole in the shell, and then enlarged it by wrenching off pieces with the lower mandible.

The Common Crossbill is found abundantly all over the continent of Europe, but especially towards the north; in some places it is constantly brought to market for the table, and appears to be highly esteemed. It also occurs in North America.

Of the two other British species, the Parrot Crossbill appears to be rather rare, not only in this country, but also on the continent. The third species, the White-winged Crossbill, is also rare in Britain, and the country in which it is most abundant appears to be the extreme northern part of America. It occurs more frequently in the northern parts of the continent of Europe than with us, and is supposed to reach this part of the world from the forests of Siberia.

The last group of this family is that of the *Phytotominæ* or Plant-cutters, distinguished from all the rest by having the margins of their mandibles finely serrated. The bill is short, conical, and stout, as in the Bullfinches. These birds are found only in the temperate regions of South America; the typical species, *Phytotoma rara*, is a native of Chili. They frequent the wooded parts of the country, and feed upon buds, fruits, and herbage, which they cut away with their bills, and thus often do great damage when they visit the cultivated grounds. The amount of the injury is greatly increased by the circumstance that the birds mischievously cut off quantities of buds, fruits, &c., for the mere pleasure of throwing them down; and for this reason, the peasants wage a constant war with them, which, according to Molina, was rapidly diminishing their numbers. They also occasionally feed on insects. Their cry is said to be exceedingly disagreeable, resembling the noise made by grating the teeth of two saws together; Molina, the original describer of the typical species, says that its native name, *rara*, is an imitation of its note.

### Sub-order II.—Dentirostres.

**General Characters.**—The leading characteristic of this group, as we have already seen, consists in the presence of a distinct notch on each side of the extremity of the upper mandible, which is also usually more or less hooked. The tarsi are usually slender, and covered with broad scales, as are also the toes, which are generally

long, and frequently armed with curved and acute claws. The outer toe is always more or less united with the middle one, and this is also the case in some instances with the inner toe.

The Dentirostres are amongst the most predaceous of the Passerine birds. The nourishment of the greater proportion of them consists principally of insects, and a good many also capture and devour small vertebrated animals. Berries and fruits likewise constitute a part of their food, but they appear very rarely to eat seeds. They are all furnished with the singing apparatus at the lower larynx, and, in fact, it is to this group that our sweetest and most celebrated songsters belong.

**Divisions.**—They may be divided into five principal families, each of which in its turn includes several subordinate groups.

In the first family, that of the *Laniidæ*, or Shrikes, the bill is elongated, strong, straight, and compressed, with the tip of the upper mandible more or less hooked, and armed on each side with a tooth (Fig. 226); the base of the bill is usually as high as broad, and the gape is furnished with bristles, of which about five spring from each side of the base of the upper mandible. The wings are of moderate size, sometimes pointed, sometimes rounded, and the first primary quill feather is usually much shorter than the second. The tail is long and rounded. The tarsi are stout, usually elongated; the hind toe long, broadly padded beneath, and the claws are long, curved, and very acute.



Fig. 226.—Head of the Red-backed Shrike (*Lanius collurio*).

The strong hooked bill and curved claws of these birds give them a very well marked resemblance to the Raptorial birds, and this similarity is almost equally striking in the habits of many of the species. They not only prey upon the insects, worms, and mollusca, which constitute the principal part of the animal food of most of the Passerine birds, but also frequently attack and destroy small birds and quadrupeds. This resemblance led Cuvier to place the Shrikes at the head of the Passeres, close to the Raptorial birds; and Linnæus and some other authors went still further, and included these birds with the Hawks and Owls in a single order.

The *Laniidæ* form only two sub-families—the *Laniinæ*, or Shrikes, and the *Thamnophilinæ*, or Bush Shrikes. The former are distinguished principally by having the ridge of the upper mandible more or less curved, whilst in the *Thamnophilinæ* it is straight, and only arched at the tip; the bill is also shorter and stouter in the Laniinæ.

The *Laniinæ*, or True Shrikes, are almost entirely confined to the Eastern Hemisphere. In the Old World they are very generally distributed, and some of the species have a very wide geographical range.

Three species are found in Britain, but of these only one, the Red-backed Shrike (*Lanius collurio*, Fig. 226), occurs in any abundance. It is a bird of passage in our climate, passing the winter in Africa, and arriving in England about the latter end of April or the beginning of May, and quitting us again in the month of September. It is generally seen in pairs, frequenting the sides of woods and hedge-rows, where it perches on the topmost twigs of the bushes to look out for prey. It is in these

situations also that it builds its nest, which is of considerable size in proportion to the bird, composed of the stalks of plants, moss, and fibrous roots, and lined with fine bent and hair.

This bird, and indeed all the common species of Shrikes, are distinguished by a singular habit, namely, that of frequently hanging their prey upon a thorn, so as to pull it to pieces with more ease. They retain this habit in captivity, and when food is given them will force a part of it between the wires of their cage, and then tug at it with their bills. Mr. Henry Doubleday also found that a tame Gray Shrike (*Lanius excubitor*, Fig. 197) hung up what it could not eat against the sides of the cage. This curious habit is referred to in many of the ordinary names of these birds. In England they are called *Butcher-birds*, and sometimes *Nine-killers*, from a popular belief that they always collect nine carcases, and impale them upon thorns, before beginning to feed. A translation of the latter name is also applied to them in German; and our common species is called *l'écorcheur*, or the Flayer, by the French. The generic name *Lanius* also means a butcher. They appear to pluck the feathers from birds before eating them, and the head of their victim is said to be the part usually first devoured. The hard and indigestible parts are thrown up in the same manner as by the rapacious birds. The Gray Shrike (*Lanius excubitor*, Fig. 197), the largest of the British species, is about the size of a Blackbird; the common species is between two and three inches shorter. The third British species, the Woodchat (*Lanius rutilus*), is about the same size as the common species; but both it and the Gray Shrike are only occasional visitors to this country. The voices of these birds are generally harsh, but they can at times adopt a softer note, and are said occasionally to mimic the songs of small birds, in order to attract them into their vicinity. This, however, is exceedingly doubtful.

One or two other nearly allied species occur on the continent of Europe, and at least two in North America; one of those inhabiting the latter region resembles the European Gray Shrike so closely, that it has been described as the same species. In their habits they are all exactly similar.

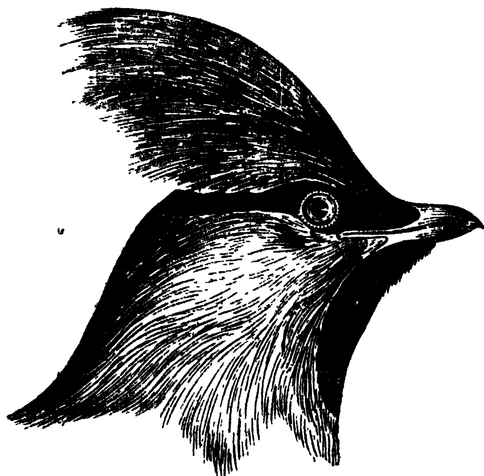


Fig. 227.—Head of Waxwing (*Bombycilla garrula*).

The East Indies possess several species of Shrikes, which appear to agree closely in all their habits with our British species. The Australian species belong to three particular genera. Of these the species of the genus *Falcunculus* feed principally upon insects, in search of which they strip the bark from the trees with their strong bills. The *Oreoica cristata*, another Australian species, hops about upon the ground more than most species of the group.

It is remarkable for the peculiar character of its voice, which commences with very low notes, sounding as though the bird was at a considerable distance, and then gradually increases in power, until the sounds seem to come from immediately over the head of the hearer, the bird having been very likely all the time perched upon a branch within a few feet of him, but so motionless that its discovery is almost impossible.

The *Thamnophilinæ*, like the true Shrikes, are principally inhabitants of the Eastern Hemisphere, although the typical genus, *Thamnophilus*, is peculiar to America. The Thamnophilinæ live amongst bushes, where they feed principally upon small insects. Their note, according to D'Azara, is merely a repetition of the syllable *tu*; and it is only heard during the breeding season.

The second family is that of the *Ampelidæ*, or Chatterers, in which the bill is rather short, broad and more or less depressed at the base, presenting a distinctly triangular form when viewed from above. The ridge of the upper mandible is curved, and the notches at the tip are distinct, though small. The wings are long and rounded; the tail usually short; the tarsi short and slender; the toes of moderate length; and the claws curved, grooved, and acute (Fig. 228).

The Ampelidæ are for the most part inhabitants of the warmer parts of the world. They feed on fruits and insects, and many of them are exceedingly beautiful in their plumage. They may be divided into six sub-families, of which the *Dicrurinæ*, or Drongo Shrikes, make the nearest approach to the Laniidæ. These birds have the ridge of the upper mandible keeled, the nostrils concealed by short plumes, the gape furnished with strong bristles, and the tarsi and toes short and strongly scutellated. The wings are long, with the fourth and fifth quills longest, and the tail is also long and usually forked at the extremity. The Dicrurinæ are only found in the Eastern Hemisphere, and they are particularly abundant in the East Indies and the Islands of the Asiatic Archipelago. Many of them are exceedingly beautiful birds, their average size is about that of a Thrush or Blackbird, and they appear to migrate from one part of the country to another with the monsoon.

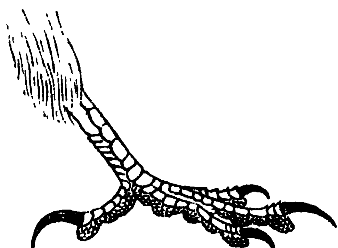


Fig. 228.—Foot of Waxwing (*Ampelis garrula*).

The commonest of the Indian species, the *Dicrurus macrocercus*, has received the name of King Crow, from its habit of persecuting the Crows, which it follows with the greatest perseverance and clamour, pouncing down upon them every now and then, but apparently seldom striking them. The principal food of this and most of the species consists of insects, especially Grasshoppers, for which they watch from some elevated perch, and on perceiving one immediately dart down upon it. For this purpose they not unfrequently establish themselves on the backs of cattle, sheep and goats, whilst these animals are grazing. They fly with great rapidity, and often capture insects on the wing. Some of the species, like the European Shrikes, appear only to have a harsh, screaming note, but others are said to be charming songsters; and one species, the *Dicrurus paradiseus*, has received the Hindoo name of "*Huzar Dustan*," or "bird of a thousand tales," from a belief that it is able to imitate the song of all other birds.

The Dicrurinæ live in the jungles and build their nests, which are composed of grass, twigs, moss, and lichen, in the forks of trees. Their architectural powers appear

to be very variable, as the nests of some of the species are described as carelessly put together, whilst others are said to be very neat. The eggs are from three to five in number, of a white or whitish colour, usually spotted with reddish-brown.

A second sub-family is that of the *Campephaginæ*, or Caterpillar-eaters, which, like the Dicrurinæ, are almost exclusively confined to the warmer parts of the Old World, only the single genus *Ptilonogonus*, being found in America. These birds have the bill short and depressed at the base, with the ridge of the upper mandible slightly curved, and the gape furnished with only a few short bristles. The nostrils are placed at the base of the bill, and exposed; the wings have the third, fourth, and fifth quills longest, and the tail is long and rounded; the tarsi and toes are short, the lateral toes unequal, and the claws much curved.

The Campephaginæ live principally in woods and forests; but some of the species are also found about hedges and gardens. They are seen either singly or in small flocks, hopping about upon the trees, and prying most inquisitively into every part of the foliage, in search of their food, which consists almost entirely of soft insects, and especially of caterpillars. They also pick up ants and beetles, and in pursuit of these are not unfrequently seen upon the ground, and fruits and berries are said to form part of the diet of some of the species. The nest is built high up in trees; it is of small size, and composed of lichens, roots, and thin stalks. The eggs are few in number, sometimes only two, of a pale colour, with brown streaks.

The third group is the sub-family of the *Gymnoderinæ*, or Fruit Crows, consisting of some remarkable birds, which have been arranged by different authors amongst the Chatterers and the Crows. They have a stout, straight, depressed bill, with the ridge of the upper mandible curved, and its tip notched. The nostrils are placed in membranous grooves on each side of the bill. The wings are long and pointed; the tail of moderate length, and rounded; the tarsi are long, the outer toe nearly as long as the middle one, and the claws long, curved, and acute.

The birds arranged in this group are peculiar to South America. They are of considerable size, some of the larger species being equal, in this respect, to our European Crows; they appear to be strictly arboreal in their habits, feeding principally upon fruits, but also occasionally upon insects. Some of the species are distinguished by having the face or part of the neck bare of feathers (*Gymnocephalus*, *Gymnoderus*), whilst, on the other hand, one of the most remarkable species has the head adorned with a beautiful crest. This is the *Cephalopterus ornatus* or Umbrella Bird, a native of Brazil, of about the size of the common Crow, and entirely of a beautiful glossy black colour, adorned with bluish metallic tints. "The crest," says Mr. Wallace, who had a good opportunity of observing the bird in its native country, "is perhaps the most fully-developed and beautiful of any bird known. It is composed of long slender feathers, rising from a contractile skin on the top of the head. The shafts are white, and the plume glossy blue, hair-like, and curved outward at the tip. When the crest is laid back, the shafts form a compact white mass, sloping up from the top of the head, and surmounted by the dense hairy plumes. Even in this position, it is not an inelegant crest; but it is when it is fully opened that its peculiar character is developed. The shafts then radiate on all sides from the top of the head, reaching in front beyond and below the top of the beak, which is completely hid from view. The top then forms a perfect slightly elongated dome, of a beautiful shining blue colour, having a point of divergence rather behind the centre, like that in the human head. The length of this dome, from front to back, is about five inches, the breadth four, to four and a-half

inches;" and it is from this elegant appendage that the name of Umbrella-bird has been derived.

This bird has another singular appendage, which is thus described by Mr. Wallace. "This is a long cylindrical plume of feathers depending from the middle of the neck, and either carried close to the breast, or puffed out and hanging down in front. The feathers lap over each other, scale-like, and are bordered with fine metallic blue. On examining the structure of this plume, it is found not to be composed of feathers only growing from the neck, as seems to have been hitherto supposed. The skin of the neck is very loose; looser and larger, in fact, than any bird I know of. From the lower part grows a cylindrical fleshy process, about as thick as a goose-quill, and an inch and a-half long. From this grow the feathers to the very point, thus producing the beautiful cylindrical plume quite detached from the breast, and forming an ornament as unique and elegant as the crest itself."

The Umbrella-bird inhabits the islands of the great South American rivers, and is said never to occur on the main land. Its food consists principally of fruits, and it ejects the stones of stone-fruits by the mouth. Its note is very loud and deep; and from this circumstance the natives of the regions of the Rio Negro give it the name of "Ucramimbé," or the Piper-bird.

Another remarkable species is the Arapunga, or Bell-bird of Guiana (*Arapunga alba*), a bird about twelve inches in length, and of a pure white colour. It is distinguished by a singular fleshy cylindrical appendage, often furnished with a few small feathers, which rises from the base of the bill; and its voice is exceedingly peculiar, exactly resembling the tolling of a bell. According to Waterton it may be heard at a distance of nearly three miles, and it is almost the only bird that produces any sound during the heat of the day, when most of the feathered inhabitants of those tropical forests are hushed in silence.

The *Ampelinæ*, or True Chatterers, have the gape very wide, extending in many instances nearly to the eyes, but destitute of bristles; the bill is broad at the base, and compressed towards the tip, which is distinctly notched; and the nostrils are placed at the base, usually of an oval form, and more or less exposed. The wings are rather long, broad, and pointed, with the second, third, and fourth quill-feathers the longest; the tail is short and even at the end; the tarsi are short, and the toes rather elongated, with curved, compressed, and acute claws.

These birds are found in both hemispheres, mostly in the warmer parts; but the genus *Ampelis* occurs in the cold northern regions of both continents. Of these birds, which are commonly known as Waxwings from the curious appendages at the extremities of some of the secondary and tertiary quills, which resemble

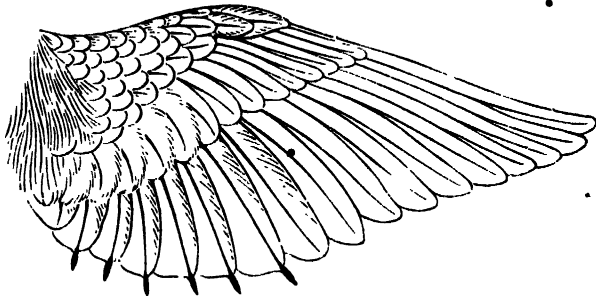


Fig. 229.—Wing of the Waxwing (*Ampelis garrula*).

small pieces of red sealing-wax (Fig. 229); one species, the Common Waxwing, or Bohemian Chatterer (*Ampelis garrula*, Fig. 227), is found in the extreme northern parts of both hemispheres; it migrates southward in very cold weather, appears in most parts of the European continent, and is an irregular visitor to our islands. It is a handsome bird, about eight inches long, of a general grayish colour, with a large patch on the throat and a band on the head black. The crest on the crown of the head and the lower tail-coverts are brownish-orange; the primary wing-coverts are tipped with white; the primary and secondary quill-feathers are black, tipped with yellow, as are also the quills of the tail; and the tertiaries are brownish-purple, tipped with white. Four of the secondaries, and from one to four of the tertials (according to the age of the bird), are terminated by the peculiar appendages above alluded to. These are small horny expansions of the shaft of the feathers, resembling, both in colour and texture, red sealing-wax.

The name of Bohemian Chatterer, commonly applied to this bird, appears to be peculiarly inappropriate, as the bird is by no means more abundant in Bohemia than in Britain, and its actual home and breeding place appears to be within the Arctic circle. It is a winter visitor to these Islands, in the northern part of which it occurs far more frequently than in the south. In this country it feeds upon the berries of the mountain ash, hawthorn, and ivy, which are all to be found abundantly during the winter upon the plants producing them; in the high northern latitudes of America, according to Sir John Richardson, it eats the berries of the juniper. The Waxwings also occasionally feed upon insects, which they capture on the wing in the same manner as the Flycatchers.

Another nearly allied species is found in North America, where it is called the Cedar Bird (*Ampelis carolinensis*). It is considerably smaller than the European species, and appears to be almost stationary, only migrating from one part of the country to another in search of particular kinds of food. It is found in all parts of North America, from Canada to Mexico, and feeds upon different kinds of berries, especially those of the red cedar, of which it is excessively fond. It is also exceedingly partial to cherries. These birds breed in June, sometimes building in the cedars, but more commonly in orchards. The nest is composed of grass, and the eggs, which are three or four in number, are of a dingy bluish white colour, variously spotted with black. When berries are abundant, as in the autumn and the beginning of summer, the birds become very fat, and are then in considerable esteem for the table.

These are the only members of the group which possess the sealing-wax-like ornaments on the wings; but many of the other species are remarkable for the brilliancy of their plumage. Amongst the most beautiful are the species of the genus *Cotinga*, of which several are found in South America.

In the sub-family of the *Piprinæ*, or Manakins, the bill is rather short, compressed, very broad at the base, with the ridge of the upper mandible curved, and the tip somewhat hooked; the nostrils more or less concealed by the frontal plumes; the tail is short, and even at the end; the tarsi long, and the outer toe is united to the middle one at least as far as the second joint of the latter.

This group is composed of numerous beautiful birds, mostly of small size, of which the majority inhabit the tropical regions of the American continent, only a single species being found elsewhere. They live in small flocks, in the hot moist forests which spread over those tropical countries, and feed upon insects and fruits. They are exceedingly active in their movements.

The only species found out of America is the *Calyptomena viridis*, a native of Singapore and Sumatra, where it lives in the heart of the forests, perching on the highest branches of the trees; as its colour is nearly the same as that of the leaves, it is by no means easily procured. This bird is supposed to feed entirely on vegetable substances, as nothing else has been found in its stomach.

Of the American species, some are black, with orange or red heads, whilst others are adorned with the most varied colours; but the head is usually of a different colour from the rest of the plumage. The largest and most remarkable species is the Cock of the Rock (*Rupicola aurantia*), a bird about the size of a pigeon, and of a fine orange colour, with the quills of the wings and tail blackish. This bird is distinguished by the presence of a singular crest of feathers arranged in two planes, rising from the sides of the head so as to meet in the middle, forming a semicircular wedge-like ornament, which projects in front over the bill. The upper tail-coverts are also remarkably elongated, curved, and decomposed, so as to form an elegant tuft upon the rump. This bird is found in Guiana, where it frequents the rocky shores of the streams; and to adapt it for this mode of life, its legs and feet are rather stout, and in its general appearance and habits bears some resemblance to the Gallinaceous birds; hence the name of Cock of the Rock, by which it is commonly known. It forms a nest of fragments of wood and dry grass in the holes of the rocks, and lays two white eggs, about the size of those of a Pigeon. Its numbers appear to be diminishing, as the colonists and Indians sell the skin at a good price. A second species, *Rupicola Peruviana*, has been brought from Peru.

The *Pachycephalinæ*, or Thick-heads, are very closely allied to the Manakins, but differ from these in the structure of the feet, the outer toe being only united to the middle one at the base. They are found in both hemispheres, but appear to be most abundant in Australia and Polynesia. They inhabit the woods and forests, and feed on fruits, seeds, buds, and insects. Like the Manakins, they are generally of very small size, and often adorned with beautiful colours.

The species of the typical genus, *Pachycephala*, occur in Australia, New Guinea, and the South Sea Islands. They build their nests amongst the branches of trees, forming it of small twigs and fibrous roots. The *Eopsaltaria australis*, which is also an Australian species, is known to the colonists of New South Wales as the *Yellow Robin*. Its nest is also built amongst the branches, and formed of strips of bark, mixed with fibrous roots, held together by cobwebs, and ornamented externally with pieces of lichen. The species of the genus *Pardalotus*, which is peculiar to Australia and Van Diemen's Land, generally build in holes of trees; and one of them (the *Pardalotus punctatus*) is said to excavate a horizontal passage of two or three feet in length in the trunk of a tree, and at the end of this to form a chamber, in which the nest, which is composed of strips of bark from the gum-trees (*Eucalypti*), is built. Another species of this genus, however, the *Pardalotus affinis*, builds a dome-shaped nest, with a small entrance-hole; it is composed of grasses and lined with feathers. This little bird is exceedingly abundant in Van Diemen's Land, where it not only frequents the gum-trees in the country, but even approaches the habitations of man, creeping about the trees in gardens and shrubberies, and inspecting every leaf in search of insects.

Several species of this group, belonging to the genus *Leiothrix*, are found abundantly in India, especially in the more northern districts. They feed principally on insects in all their stages; and in search of these make such a diligent inspection of

the opening buds of the trees, that, according to Mr. Hodgson, they might be denominated "Bud-hunters." They also eat berries and seeds. Their nests are usually built in small bushes, and composed of grass and hair; the eggs are said to be "black spotted with yellow."

In the interesting family of the Flycatchers, or *Muscicapidæ*, which closely resemble the Shrikes in their general habits, the bill is generally straight, broad and depressed at the base, with the gape wide, and furnished with long stout bristles springing from the base of the upper mandible. The wings and tail are long, and the legs short and weak, with the toes more or less elongated. The Flycatchers are small birds, none of them equalling our common Jackdaw in size. They feed for the most part upon insects, which they take upon the wing, establishing themselves in some elevated position, from which they dart off after their prey, and returning again to their post to swallow it. The larger species, however, like the Shrikes, are not content with such small game, but make war upon the smaller vertebrate animals.



Fig. 230.—Head of the Spotted Flycatcher (*Muscicapa griseola*).

Of the five sub-families into which this group is divided, the first is that of the Greenlets (*Vireoninæ*), a group of small American birds, of which the general plumage is usually more or less tinted with green or olive. They have a short straight bill, and the bristles of the gape are short and weak; the wings are long and pointed, and the toes of moderate size, the lateral ones being about equal, and both more or less united to the middle one at the base.

These birds are all of small size, the largest being not more than seven inches in length. They migrate from the tropical regions of America, Brazil, Guiana, and the West Indian Islands, to the United States, arriving in the latter country about the month of May, breeding there in the summer, and returning southwards in August and September. Some of them have an exceedingly sweet warbling note, whilst the song of others appears to have little merit. One of them, the Red-eyed Flycatcher (*Vireo olivaceus*), is well known in Jamaica by the name of "Whip-Tom-Kelly," from a supposed resemblance of its notes to these words; and Wilson says, that "on attentively listening for some time to this bird, in his full ardour of song, it requires but little of imagination to fancy that you hear it pronounce these words, 'Tom-Kelly, whip-Tom-Kelly!' very distinctly." Mr. Gosse, however, is of a different opinion, and states that its notes bear a very close resemblance to the syllables "John-to-whit," pronounced with an emphasis on the last syllable.

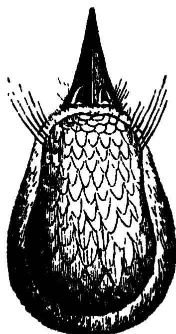


Fig. 231.—Head and Foot of the Spotted Fly-catcher (*Muscicapa griseola*).

The Vireoninæ feed almost entirely upon insects, some apparently preferring beetles and other hard-skinned species, whilst others principally devour the small insects

which they take on the wing, and others, again, appear to have a predilection for caterpillars, for which they search the leaves of the trees. They also occasionally eat berries.

They build their nests sometimes in trees, sometimes in thick bushes, forming them of dry leaves, grass, fibrous roots, moss, and lichens; but the materials vary somewhat in the different species, one of them, the White-eyed Flycatcher (*Vireo noveboracensis*), being noted for always introducing fragments of paper into the construction of its nest, and these, according to Wilson, are so constantly pieces of newspapers, that some of his friends proposed to call the bird the *politician*.

The Red-eyed Flycatcher (*Vireo olivaceus*), to which we have already referred, builds a neat pensile nest, which is generally suspended between two twigs of some small tree or bush, rarely at a greater height than four or five feet from the ground. In addition to the materials already enumerated, this nest usually includes pieces of hornet's nests, flax, and pieces of paper, and the whole is glued together, according to Wilson, with the silk of caterpillars and the saliva of the bird. These nests are very durable, and Wilson mentions his having found a nest of the Yellow bird (*Carduelis tristis*), built in the last year's nest of the Red-eyed Flycatcher. The mice, also, frequently take possession of them after their owners have taken their departure. The White-eyed Flycatcher (*Vireo noveboracensis*), also makes a pendulous nest. Most of these birds produce two broods of young in the course of the season, each laying consisting of four or five eggs; these are of a white colour, more or less spotted with brown or black. Their nests are often selected by the Cowpen bird (*Molothrus pecoris*, page 264) for the reception of its eggs.

In general, when the birds of this sub-family have established themselves in some suitable situation, they exhibit great jealousy of any intruder upon their domain; and some of them vituperate any passer-by in a most extraordinary fashion. One of the most remarkable in this respect is the Yellow-breasted Chat of Wilson (*Icteria viridis*), of which that author gives the following curious account. He says, they commence "scolding every passenger as soon as they come within view, in a great variety of odd and uncouth monosyllables, which it is difficult to describe, but which may be readily imitated, so as to deceive the bird himself, and draw him after you for half a quarter of a mile at a time, as I have sometimes amused myself in doing, and frequently without once seeing him. On these occasions, his responses are constant and rapid, strongly expressive of anger and anxiety; and while the bird itself remains unseen, the voice shifts from place to place, among the bushes, as if it proceeded from a spirit. First is heard a repetition of short notes, resembling the whistling of the wings of a duck or teal, beginning loud and rapid, and falling lower and lower, till they end in detached notes; then a succession of others, something like the barking of young puppies, is followed by a variety of hollow, guttural sounds, each eight or ten times repeated, more like those proceeding from the throat of a quadruped than that of a bird; which are succeeded by others not unlike the mewing of a cat, but considerably hoarser. All these are uttered with great vehemence, in such different keys, and with such peculiar modulations of voice, as sometimes to seem at a considerable distance, and instantly as if just beside you; now on this hand, now on that; so that from these manœuvres of ventriloquism, you are utterly at a loss to ascertain from what particular spot or quarter they proceed." The bird that makes all this fuss, although one of the largest in the group, is only about seven inches in length.

The second sub-family, which includes a great number of species, is that of the

*Muscicapinæ*, or True Flycatchers. In the form of the bill they closely resemble the Vireoninæ; but this organ is rather longer, and has the ridge slightly flattened at first, but curved towards the tip. The gape is furnished with bristles; the wings are long and pointed, and the toes are short, the outer lateral toe being longer than the inner one.

These birds, which exhibit the characteristic habits of the family in their greatest perfection, are pretty generally distributed over both hemispheres, but more especially in the tropical regions. The species which occur in Europe and the temperate and colder regions in general, are summer birds of passage; the European species arrive in April and May, and leave again for their southern winter quarters about the month of October.

Only two species occur in Britain. The most abundant of these is the Spotted Flycatcher (*Muscicapa griseola*, Figs. 231 and 232), a small bird about six inches in length, of a brownish tint above, with a few dark spots on the top of the head; beneath dull white, with brown streaks on the throat and breast. This bird arrives in England very regularly in the month of May, and commences building its nest immediately on its arrival. For this purpose it often selects most singular situations—a pair have been known to build on the head of a garden rake, which had been accidentally left standing near a cottage; another pair built in a bird cage; but the most curious instances of caprice in this matter are those of two pairs of these birds which selected street lamp-posts for the purpose of nidification. One of these is recorded by Atkinson as having occurred in Leeds; the nest was built on the angle of a lamp-post, and the parents succeeded in rearing their young. In the other instance, which is referred to by Mr. Jesse, the nest was made in the ornamental crown on the top of one of the lamps in Portland Place; it contained five eggs, which had been sat upon; and Mr. Yarrell states that he saw the nest in its curious receptacle at the Office of Woods and Forests.

In general, the nest is placed in a hole in a wall, in a faggot stack, or an out-building, but the branches of trees trained against a wall are sometimes selected for its reception. The nest is cup-shaped, and generally composed of moss lined with fine grass, and sometimes feathers and horse-hair; it is beautifully made, and the female is supposed to be the architect. The eggs are four or five in number, of a bluish-white colour, spotted with red.

These birds appear to feed entirely upon insects, which they capture on the wing, and when on the look out for food, may be seen standing upon the top of a post, or the top rail of a fence, from which they dart off the moment they perceive an insect within their reach, and usually return nearly to the same spot to look out for fresh prey. They are very common in gardens and orchards, and from their being often seen in such situations at the season when cherries and raspberries are ripe, they have been accused of eating these fruits; but Mr. Yarrell states that the stomachs of Flycatchers killed under these circumstances have been found to contain no remains of fruit, so that it is more probable that they only resort to the neighbourhood of the trees for the sake of the insects which are attracted there by the ripe fruit. The Spotted Flycatcher is found on the Continent of Europe as far north as Norway and Sweden, and it also occurs in Africa, even as far south as the Cape of Good Hope.

The other British species is the Pied Flycatcher (*Muscicapa atricapilla*, Fig. 232), which visits this country in April and leaves it again for the south in September. It is far less abundant than the preceding species, and only occurs plentifully in particular localities, especially in the neighbourhood of the lakes of Cumberland and West-

moreland. In its general habits it closely resembles the Spotted Flycatcher, but it builds its nest in the holes of trees and sometimes lays as many as eight eggs. It is also said to have a pleasing song, whilst the other British species is only able to produce a chirping note. The Pied Flycatcher occurs in most parts of Europe, but is particularly abundant in the countries bordering on the Mediterranean.



Fig. 232.—Head of the Pied Flycatcher (*Muscicapa atricapilla*).

Several species of this group also occur in North America. They resemble their European relatives in their habits, and like these are summer birds of passage. Some of them are said to feed occasionally upon berries.

One of the most elegant and singular of the exotic species is the Paradise Flycatcher (*Tchitrea Paradisi*), which is generally distributed over the continent of India, living principally in the dense bamboo jungles. It is remarkable for the great length of the tail, which is considerably more than twice as long as the body; the latter measuring only about six inches in length, whilst the tail is thirteen or fourteen inches. The head is also adorned with a crest. Like the common species it catches its insect food in the air, but also occasionally picks it off the branches of the trees, and Colonel Sykes says that it feeds on the ground. Some nearly allied species are found in India and Africa.

Many other species of this sub-family are found in India, Australia, and Africa, but they all appear to be very similar in their habits. Some seldom or never take their food otherwise than on the wing, whilst others pick caterpillars and other insects from the leaves and branches of the trees, and some even settle upon the ground to capture their prey. Some of the species have merely a chirping or chattering note, whilst the song of others is described as sweet and pleasing.

Closely allied to the true Flycatchers are the *Tityrinæ*, or Becards, a small group of birds peculiar to South America and the West Indian Islands. These birds have the bill short, broad at the base, and suddenly compressed towards the tip; the nostrils rounded and exposed; the wings long and pointed, and the tail short. The tarsi are short, covered with narrow scales, and the lateral toes are nearly equal in length. The Tityrinæ are small birds, which closely resemble the Flycatchers in their habits, perching on an elevated place to look out for insects, which they take on the wing and then return to their resting-place.

The *Tyranninæ*, or Tyrant Flycatchers, are also very closely allied to the Muscicapinæ, from which in fact they differ principally in having the tip of the bill more strongly hooked. The bill itself is larger than in the true Flycatchers, very broad at the base and gradually compressed to the tip; the gape is usually furnished with long bristles, and the nostrils are generally of small size and concealed by the frontal plumes.

These birds are all inhabitants of America, and principally of the tropical parts of that continent. They resemble the Shrikes a good deal in their habits, preying not only upon Insects, but also upon small Vertebrate animals, including even Fishes. They also feed on berries.

Two or three species of this group are well known in the United States of North America, where, however, they are only summer visitors. The best known is the King-

bird, or Tyrant Flycatcher (*Tyrannus intrepidus*), a bird about eight inches in length, of a dark slaty ash colour above, and white beneath; the feathers of the crown of the head are of a brilliant orange colour, and capable of being erected, so as to form a sort of crest, which has been compared with a crown or diadem, and from this, and the tyrannical authority which the bird exercises over all its neighbours during the breeding season, its common names of King-bird and Tyrant are derived.

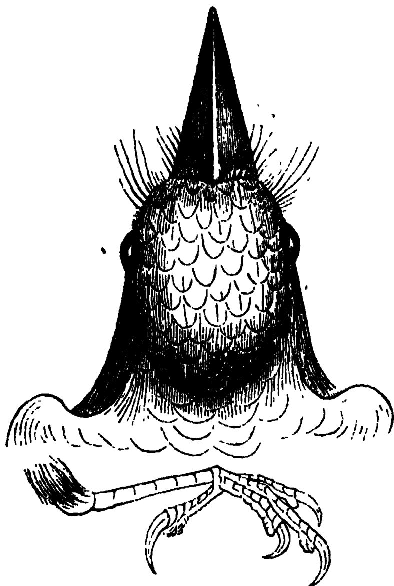


Fig. 233.—Foot and Head of the Crested Tyrant (*Tyrannus crinitus*).

The King-birds arrive in small parties in the United States in the month of April, and about the beginning of May they pair, and begin to build their nests. The nest is built in a tree, frequently in orchards; it is composed externally of twigs, and similar materials, finely woven together with tow and wool, and lined with fine grass and horse-hair. The birds lay five eggs, and generally breed twice in a season.

At their first arrival in the United States, they are particularly quiet, but with the commencement of the breeding season, a complete change comes over the spirit of the male bird. "At that season," says Wilson, who has given an admirable history of this Flycatcher, "his extreme affection for his mate, and for his nest and young, makes him suspicious of every bird that happens to pass near his residence, so that he attacks, without discrimination, every intruder. In the months of May, June, and part of July, his life is one continued scene of broils and battles, in which, however, he generally comes off conqueror. Hawks and Crows, the Bald Eagle, and the Great Black Eagle, all equally dread a rencounter with this dauntless little champion, who, as soon as he perceives one of these last approaching, launches into the air to meet him, mounts to a considerable height above him, and darts down on his back, sometimes fixing there, to the great annoyance of his sovereign, who, if no convenient retreat or resting-place be near, endeavours, by various evolutions, to rid himself of his merciless adversary. But the King-bird is not so easily dismounted. He teases the Eagle incessantly, sweeps upon him from right to left, remounts, that he may descend upon his back with the greater violence, all the while keeping up a shrill and rapid twittering, and continuing the attack sometimes for more than a mile, till he is relieved by some other of his tribe equally eager for the contest." Occasionally the King-bird meets with his match in the Purple Martin (*Progne purpurea*), which, from his great rapidity of flight is enabled, with impunity, to tease his quarrelsome neighbour, and even sometimes to drive him to seek safety in flight. The Redheaded Woodpecker, also, has been seen by Wilson amusing himself by dodging his impetuous assailant round the rail of a fence, a proceeding which appeared to irritate the little warrior

exceedingly. With the close of the breeding season all this turbulence ceases, and the King-bird becomes as mild and peaceable as any other bird.

The food of the Kingbird consists principally of insects, which he captures sometimes in the manner of the European Flycatchers, by watching for them from the top of a post, or fence, and sometimes by hovering slowly over the fields and rivers, like a hawk. In this manner he destroys vast multitudes of noxious insects; but unfortunately he has a habit w' ·ch causes him to be regarded with some little disfavour; he is exceedingly partial to bees, and may be constantly seen perched upon a fence near the hives, and dashing down upon the industrious little insects as they pass to and from their homes. Thi. a habit is often the cause of his death; but there can be no doubt of the truth of Wilson's statement, that fc any damage he does to the bees he compensates fifty fold in the destruction of other insects which would have injured produce of far greater importance.

Another North American species is the Crested Tyr..t (*Tyrannus crinitus*, Fig. 233), a bird a little larger than the Kingbird, of a greenish olive colour above, and sulphur-yellow beneath, with the throat and the upper part of the breast ash colour. The feathers of the head are centred with dark brown, and form a sort of crest. This bird in most of its habits resembles the Kingbird, but it is destitute of the courage which prompts the latter to enter into such unequal contests. It generally inhabits the woods, and builds in holes of trees. The nest is remarkable for the materials of which it is composed. These consist, according to Wilson, of "hay, feathers, hogs' bristles, pieces of cast snakes' skins, and dog's hair;" and he adds, "snakes' skins with this bird appear to be an indispensable article, for I have never yet found one of his nests without this material forming part of it."

The last group of this family is t... sub-family of the *Alectrurinæ*, or Alectrures, in which the bill is broad and depressed at the base, convex towards the point, which is more or less hooked; the nostrils are rounded and exposed; the tail is elongated, compressed, and capable of being raised in a very singular manner, which has caused the birds to be compared to *little Cocks*, and the scientific name of *Alectrurus* applied to the typical genus may, perhaps, be translated *Cock-tail*. The tarsi are slender, and the toes armed with long, curved, and acute claws.

These birds are peculiar to South America, and in their general habits resemble the ordinary Flycatchers. Many of them perch upon trees and bushes, and thence dash off into the air in pursuit of insects on the wing; others are never seen in the neighbourhood of woods, but appear to prefer fields in the vicinity of water, where they rest on the rushes and other aquatic plants. It is in the male only that the great development of the tail above alluded to is seen, and the feathers of this part exhibit several peculiarities of structure. The two external feathers have the barbs much broader on one side than on the other, and the two central feathers, which are the most elongated, frequently have the barbs decomposed, and the termination of the shaft naked. They are small birds, the typical species (*Alectrurus tricolor*), being only about six inches in length.

The Flycatchers are followed by the great family of the *Turdidæ*, or Thrushes, which includes many of the most esteemed songsters of various parts of the world. In these birds the bill is usually of moderate length, rather stout, and compressed towards the end. The ridge of the upper mandible is keeled and slightly convex; its tip is rather acute, and furnished with a small notch or tooth on each side. At the base of the upper mandible on each side of the gape there is a row of bristles (Fig. 237),

which, however, never attain the same dimensions as in the preceding family; and in some cases are so small as to escape observation, unless carefully examined. The nostrils are situated on each side of the base of the bill, generally oblong in form, and partially protected by a membranous scale. The wings (Fig. 234) are tolerably long, broad, and either rounded or pointed at the end, with the first quill very small. The legs are usually rather short and moderately stout; the tarsi are compressed, and covered in front with seven shields (Fig. 239), several of which, however, are frequently amalgamated into a single plate (Fig. 235).

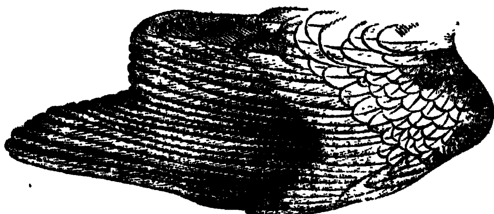


Fig. 234.—Wing of the Blackbird (*Turdus merula*).

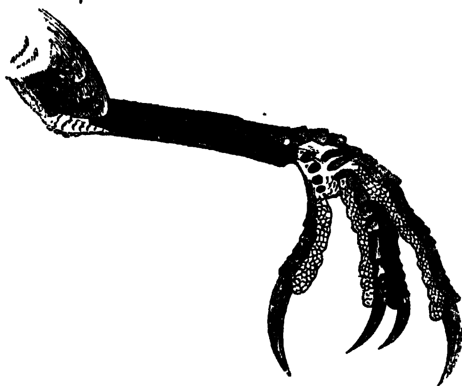


Fig. 235.—Foot of the Blackbird (*Turdus merula*).

In their general form these birds present a considerable resemblance to the smaller species of Crows and Starlings; but they are usually more slender than these birds and inferior to them in size; our common Blackbirds and Thrushes being amongst the largest species. They feed indifferently upon insects, worms, and fruits; but appear rarely to take their insect food upon the wing, like the Flycatchers. On the ground, unlike the Crows and Starlings, they move by hopping with both feet at once; but their flight is less undulating than that of the generality of the smaller Passerine birds. The species are generally distributed in all parts of the world.

Of the five sub-families into which this great group is divided, the first is that of the *Pycnonotinæ*, or Bulbuls, which are all exotic birds, peculiar to the Eastern Hemisphere. They have the bill short and compressed, with the ridge of the upper mandible curved and the gape furnished with bristles; the nostrils are placed in a short membranous grove; the tarsi are not longer than the middle toe, and usually covered by a single plate, and the outer toe frequently longer than the inner one.

These birds are found abundantly in the East Indies, and some species also inhabit Africa. They are the *Bulbuls* of the former country, where several of the species are greatly admired as songsters. They inhabit woods, jungles, and gardens, and feed principally on fruits and seeds, but also occasionally on insects, which they capture on the ground. The sprightliness of these birds renders them favourites with the natives of India; and one species, the *Pycnonotus jocosus*, which is very easily tamed, is taught to sit upon its master's hand; and great numbers thus carried may be seen in the

Indian bazaars. Another, the *Pycnonotus hæmorrhous*, is kept in the Carnatic for the purpose of fighting, which it does, according to Dr. Jerdon, with some spirit. The under tail-coverts are red, and it is said that the combatants endeavour to seize and pull out these feathers.

The nests of these birds are made of twigs, the stalks of plants, fibrous roots, moss, lichen, &c., frequently lined with hair or down. Their eggs are usually three or four in number, of a whitish colour with dark spots or blotches.

A single specimen of a South African species of this group, the Gold-vented Thrush (*Pycnonotus aurigaster*), has been killed near Waterford; but whether it had strayed so far from its ordinary home, or had escaped from confinement, it is of course impossible to say. Temminck states that another species, which he calls *Ixos obscurus*, and which is common in the north of Africa, has been found in Andalusia.

In the second sub-family, that of the *Oriolinæ*, or Orioles, the bill is rather long, strong, nearly straight, with the ridge of the upper mandible slightly curved, and its sides sloping at the base. The bristles of the gape are very small, so as not to be readily observable; the wings are rather long; the tail moderate, straight, and rounded at the extremity; the tarsi are short, covered with seven scales in front, the toes moderate, the anterior ones united at the base, and all furnished with curved, acute claws.



Fig. 236.—Head of the Golden Oriole (*Oriolus Galbula*).

The Orioles are all confined to the Eastern Hemisphere. They were formerly included in the same group with the Troopials, which now form the sub-families Quiscalinæ and Icterinæ, amongst the Sturnidæ—and this approximation was probably owing entirely to a certain resemblance in the colour of the plumage, for the characters of the birds are very different.

The true Orioles live in woods and shrubby places, usually in pairs, suspending their nests, which are beautifully constructed, at the extremities of the branches of trees. The males are generally beautiful birds, a golden yellow being the predominant colour in their plumage. They live on insects and fruits.

These birds are, for the most part, inhabitants of tropical countries; but a single species, the Golden Oriole (*Oriolus Galbula*, Fig. 236), migrates into Europe, in the southern parts of which it is abundant, although it is only occasionally that specimens visit this island. The Golden Oriole is of a bright yellow colour, with the wings and tail black; the female is greenish-yellow above, and whitish beneath, with the wings and tail brown instead of black. It is about the size of the common Blackbird.

In the south of Europe this bird arrives in the spring, and then frequents low wooded districts, feeding at first upon insects and their larvæ, but afterwards upon fruits of various kinds, especially cherries, in search of which it frequently visits the

gardens. It differs remarkably from the other members of the group in the mode in which it constructs its nest, which is of a flattened, saucer-like form, placed in the fork of a branch of a tree, and composed of grass and wool. Nevertheless, it is said by some authors to form a purse-shaped pendent nest, like the tropical Orioles. The eggs are usually four or five in number; white, with dark spots.

The voice of the Golden Oriole is loud, and has been compared to the sound of a flute; Bechstein says it resembles the word *puhlo.* The names given to the bird in different European languages are also supposed to be, to a certain extent, imitations of its note. The Spaniards call it *Turiol*, the French *Loriot*, the English *Oriole*; and two of the German names are *Pirol* and *Bülow*. The Italian peasantry are said to believe that the bird kindly indicates the ripening of the figs, pronouncing notes in which they recognize the words *Contadino è maturo lo fico;* it would seem more natural, however, that the Oriole should take advantage of his knowledge of this fact to help himself, without troubling himself about informing his human neighbours of it. The note of some of the Indian species is described by different observers as very similar to that attributed by Bechstein to the European bird. A very nearly allied species, the Mango-bird or Golden Oriole of India (*Oriolus Kundoo*), is said by Dr. Jerdon to have "a loud, mellow, plaintive cry, something resembling *pee-ho*;" and Mr. Pearson says of the Black-headed Oriole (*O. melanocephalus*), which is exceedingly common in Bengal, that it has a monotonous, low note, resembling "one lengthened full-toned note on the flute," which is so constantly repeated during the spring that it is a positive nuisance.

Most of the foreign species of the group resemble the Golden Oriole, both in characters and habits; but one species, the Regent-bird, or King Honey-eater (*Sericulus chrysocephalus*), of Australia, is remarkable from its having the tip of the tongue terminated by a pencil of fine filaments like that of the Honey-eaters (*Meliphagidæ*), amongst which this bird has indeed been placed by some authors. The male is one of the most beautiful of Australian birds; its plumage, which is very glossy and satin-like, is variegated with two colours, deep black and brilliant yellow, the latter tinged with orange in some places. The female is dingy in its appearance. The Regent-birds are found in the warmer parts of the Australian continent, where they inhabit the recesses of the forests, and appear to be exceedingly shy. They feed upon fruits and seeds.

The third sub-family is that of the *Timalinæ*, or Babblers, a group of birds confined to India, the Eastern Archipelago, and Australia. They have the bill usually elongated, with the ridge of the upper mandible much curved throughout, and the tip entire or but slightly notched. The nostrils are placed at the base of the upper mandible, usually in an oval groove, and have the aperture more or less exposed; the wings are rounded, the third, fourth, and fifth, and sometimes the sixth and seventh quills being longest; the tail is graduated; the tarsi are elongated and stout, usually covered in front by a single plate; and the toes moderate or long and strong, furnished with stout, compressed, curved, and acute claws, of which that on the hinder toe is usually much longer than its fellows.

The birds composing this group are of small size, and, like the Corvidæ, which they resemble in their noisy habits, are gregarious. They frequent the forests and woods exclusively, but except for the purpose of nidification and roosting, they rarely perch upon the trees, their food consisting for the most part of insects, which they pick up on the ground, and in search of which they often scratch in the earth

with their bills and feet, in the manner of the Rasorial birds. They are commonly seen upon the roads and pathways which lead through the forests, attracted there by the insects which come to seek the dung of passing animals, but on some occasions, when their ordinary food is scarce, they appear to seek caterpillars upon the trees, and sometimes feed on fruits. Fruits also appear to constitute the principal food of some species. They build their nests usually in the lower branches of trees, forming them of twigs, roots, grass, moss, and lichens. Their eggs are usually from two to four in number, and vary greatly in colour; those of some species being blue or green, those of others pure white, or white with brown blotches.

Many of the species have a sweet song, and some are excellent imitators of other birds. Some are noted for a singular cry, which resembles a loud human laugh, and this peculiarity has obtained for two or three of the species the names of the Laughing Crow and Laughing Thrush from the Europeans in India. The cry of the Laughing Thrush (*Pterocyclus cachinnans*) is said by Dr. Jerdon to be a peculiar "sort of cracked Punch and Judy laugh," which is no sooner commenced by one than several others take up the chorus. The *Garrulax leucolophus*, or Laughing Crow, is also said to produce a sound closely resembling the human laugh.

In confinement, these birds are easily tamed, and appear to be rather amusing pets. Mr. R. W. G. Frith has given the following account of a specimen of the Black-faced Thrush of India (*Garrulax chinensis*), which he kept for some time. "The bird," he says, "was excessively tame and familiar, and delighted (like a cockatoo) in being caressed and tickled by the hand, when it would spread out its wings and assume very singular attitudes. It was naturally a fine songster, and a most universal imitator. Whenever chopped meat or other food was put into its cage it always evinced the propensity to deposit the bits one by one between the wires; and when a bee or wasp was offered, this bird would seize it instantly, and invariably turn its tail round and make the insect sting this several times successively before eating it. A large beetle it would place before it on the ground, and pierce it with a violent downward stroke of the bill; a small snake (about a foot long) it treated in like manner, transfixing the centre of the head; it afterwards devoured about half the snake, holding it by one foot, while it picked it with the bill, as was its common mode of feeding."

One of the Indian species, the *Malacocircus Malcolmi*, appears to be a bird of great courage; for although its flight, like that of the other members of the group, is by no means strong, yet if a small hawk be flown at a flock of the species, they will immediately mob the hawk, endeavouring to compel it to release the one it has seized.

The Spotted Ground-Thrush of Australia (*Cinclosoma punctatum*), is another species of this sub-family. It inhabits the eastern part of Australia and Van Diemen's Land, and its habits appear to be more decidedly terrestrial than those of any other of the group. According to Mr. Gould, it frequents low stony hills and rocky gullies, especially those covered with shrubs and grasses. Its power of flight is very small, and rarely exercised, except for passing from one bush to another; but on the ground it runs with great swiftness.

The nest is carelessly made of leaves and the bark of trees, and placed on the ground under the shelter of a large stone, the stump of a tree, or a tuft of grass. The eggs are generally two in number, white, with large olive-brown blotches. Its flesh is said to be exceedingly delicate, and in Hobart Town it is frequently sold in the market with other small birds; it is there called the Ground Dove.

In the *Turdinæ*, or true Thrushes, the bill is of moderate length, usually about as long as the head, tolerably stout and compressed, with the upper mandible notched at the tip and its ridge curved; the gape is furnished with bristles, and the nostrils are placed at the base of the bill, with their opening exposed. The wings are rounded, with the first quill very short, the third and fourth longest; the tarsi are rather long, sometimes covered with seven shields in front, but more frequently either with a single long plate, or with three or four shields and a plate, and the toes are long and stout, the outer one longer than the inner and united to the middle toe at the base, and all furnished with curved and acute claws.

The Turdinæ are found in all parts of the globe, generally frequenting fields and pastures in search of food, but retiring to the woods and thickets for security when roosting and during the breeding season. Their nests are usually very neatly made, comprised of grasses, twigs, and moss, frequently lined with a thin layer of mud, within which is another layer of soft vegetable substances for the reception of the eggs. The latter are usually five or six in number; variable in colour, but commonly freckled with dark spots. The food of the Thrushes consists both of animal and vegetable matters, such as insects and their larvæ, worms, snails, fruits and seeds.

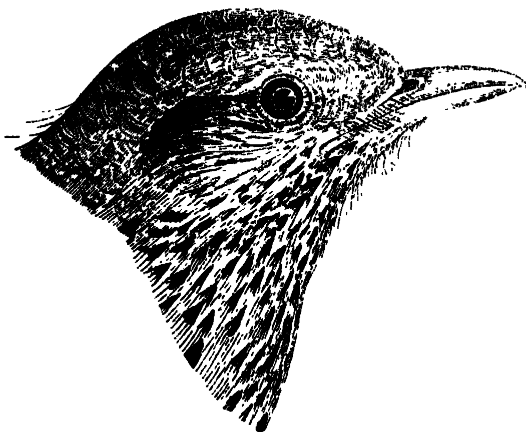


Fig. 237.—Head of the Thrush (*Turdus viscivorus*).

Seven species have been found in Britain, of which one, which has been described under the name of White's Thrush (*Turdus Whitei*), only visits Europe occasionally, and appears to be positively identical with a Japanese species, which again is very closely allied to a species from Java, described by Dr. Horsfield under the name of *Turdus varius*. Indeed, by some authors, the *Turdus Whitei* has been regarded as identical with Dr. Horsfield's species. Of the remaining six species, three, namely the Blackbird (*Turdus merula*), the Missel Thrush (*T. viscivorus*, Fig. 237), and the Song Thrush (*T. musicus*), are permanent residents, whilst the others are regular visitors; two of them, the Fieldfare (*T. pilaris*) and the Redwing (*T. iliacus*), in winter, and one, the Ring Ouzel (*T. torquatus*), in summer.

The Missel Thrush (*T. viscivorus*) is the largest of our species, and one of the largest birds in the group, measuring about eleven inches in length. It is not a very abundant bird; but is pretty generally distributed, frequenting small woods and copses, and occasionally trees in hedges. It breeds early in the spring, usually in April, and the song of the male, which resembles that of the Blackbird, is sometimes commenced as early as February. During the breeding season the Missel Thrush is very quarrelsome, driving all the smaller birds away from its neighbourhood; hence,

according to Pennant, the Welsh have given it the name of *Penn y llwyn*, or the master of the copse. It feeds to a great extent upon berries, and is said to be particularly addicted to those of the misseltoe, from which its common name is derived; in this manner it is supposed to perform an important part in the diffusion of that singular plant.

The well-known Song Thrush (*Turdus musicus*, Fig. 238), universally considered one of the finest of our larger singing birds, is considerably smaller than the Missel Thrush, measuring only about nine inches in length. It is very generally distributed in all places not quite destitute of wood, and is very commonly seen in gardens, where it probably compensates for the damage it does to some portions of the produce by the numbers of insects and other injurious animals which it destroys. Its mode of getting at the shelled-snails, so common in gardens, evinces considerable ingenuity; it takes the animal up in its bill, and strikes it against a stone until the shell is fractured, when the unfortunate inmate is speedily extracted. During the winter our native Thrushes are reinforced by arrivals from the northern countries of Europe, which are quitted by these birds towards the close of autumn.

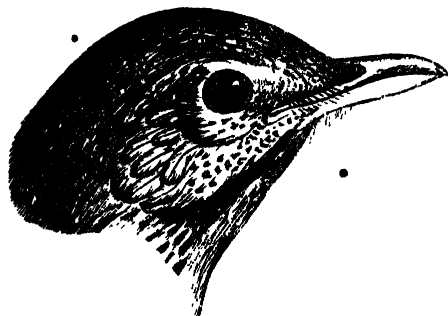


Fig. 238.—Head of the Song Thrush (*Turdus musicus*).

The Redwing (*T. iliacus*) and the Fieldfare (*T. pilaris*), our winter visitors, present some resemblance to the common Thrush in the arrangement of their colours; the former is a little smaller, and the latter rather larger than that species. These birds associate in flocks during their abode with us, usually frequenting the fields in search of the insects, worms, &c., which constitute their food. Whilst in this country, only their call-note is heard; this is harsh and unmusical, but their summer song is said to be exceedingly pleasing. In the other two species, the Blackbird (*T. merula*) and Ring Ouzel (*T. torquatus*), the plumage is black, but the latter has a broad crescent-shaped white stripe across the breast. In their habits they resemble the Thrushes.

Most of the British species possess a pleasing song, but the Blackbird and the Song Thrush are pre-eminent in this respect, and are, in fact, to be regarded as amongst the most beautiful of our songsters. They are, however, exceeded by another species of the group, the North American Mocking Bird (*Mimus polyglottus*) whose natural song is said to be most beautiful, whilst he possesses a most extraordinary power of mimicking the notes of other birds, and even the cries of the most dissimilar animals—indeed, his ordinary song is said almost always to include imitations of his feathered neighbours. Thus, according to Wilson, when the Mocking Bird is in the full career of his song, "a bystander, destitute of sight, would suppose that the whole feathered tribe had assembled together on a trial of skill, each striving to produce his utmost effect, so perfect are his imitations. He many times deceives the sportsman, and sends him in search of birds that perhaps are not within miles of him, but whose notes he exactly imitates; even birds themselves are frequently imposed on by this admirable mimic, and are decoyed by the fancied calls of their mates, or dive with precipitation into the

depths of thickets at the scream of what they suppose to be the Sparrow-hawk." These constant imitations of other birds, however, are frequently injurious to the song of the bird, as he introduces the most discordant elements into his "Monopolylogue," interrupting his own song, or his wonderful imitations of the notes of fine songsters, with the crowing of cocks, the cackling of hens, and similar sounds. In domestication his habits appear to be exceedingly amusing, as, like the Parrots, and many of the Corvine birds, he seems to pick up the different household noises with great facility. Thus, Wilson states he will whistle to the dog, and disturb him from his repose in the expectation of seeing his master; he will squeak out like an injured chicken, so as to alarm the maternal feelings of the hen; and then give the barking of the dogs, the mewing of cats, and various sounds produced by things animate and inanimate, with astonishing fidelity. Like our own nightingales, he sings sweetly during the night, commencing as soon as the moon rises, and Wilson states that the hunters in the Southern States know that the moon is rising when they hear the Mocking Bird begin to sing. This bird also occurs in the West Indian islands and South America, and Mr. Gosse describes it as singing most beautifully during the night in Jamaica. Several other species of Thrushes are found in the United States, and most of these are described as charming songsters.

In hot climates the Turdinæ appear generally to inhabit the mountainous districts; some of the Indian species are found at an elevation of five or six thousand feet above the level of the sea. Some of them belonging to the genera *Petro cinela* and *Orocetes* inhabit rocky places, and build in the holes of the rocks.

The *Formicarinæ*, or Ant Thrushes, constituting the last group of this family, closely resemble the Thrushes in their characters, but have the wings and tail much shorter. In the form of the bill they are very similar to the True Thrushes, but the tip is often slightly hooked and the nostrils are placed in a membranous groove. The tarsi are long, sometimes covered in front with several scales (Fig. 239), sometimes with a single, long plate (Fig. 241). They are, for the most part, inhabitants of the tropical regions of both hemispheres, where they live in the forests and thickets, sometimes perching upon bushes and the lower branches of trees, sometimes living principally upon the ground. Their food consists almost entirely of insects, principally Coleoptera and Ants, and from the great numbers of the latter insects which they destroy in some localities, especi-

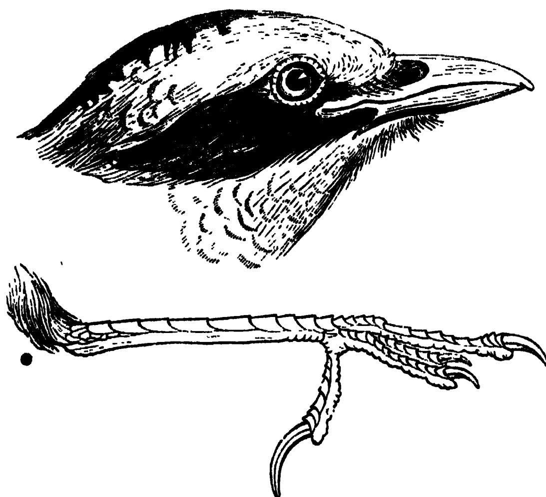


Fig. 239.—Head and Foot of Pitta Bengalensis.

ally the tropical forests of South America, the name of Ant-Thrushes commonly given to these birds is derived.

From the shortness of their wings these birds generally fly very indifferently, and Mr. Hodgson remarks of one species, the *Pitta nipalensis*, that its flight is so bad that he has seen it taken by a man. Dr. Horsfield established the genus *Brachypteryx*, for a Javanese species of this group (*B. montana*), in which the abreviation of the wings appears to be carried to its extreme. He says that it is quite unable to undertake long or elevated flights, and that its movements are always made with great exertion. This bird, like most of the other members of the group makes its nest upon the ground.

The species of the genus Pitta, which are peculiar to the Eastern Hemisphere, are generally adorned with beautiful colours, a brilliant azure blue being a very prevalent tint in their plumage. The numerous South American species of Ant Thrushes belonging to the genus *Formicarius* and its allies are more sober in their tints, their plumage usually exhibiting different shades of brown and white.

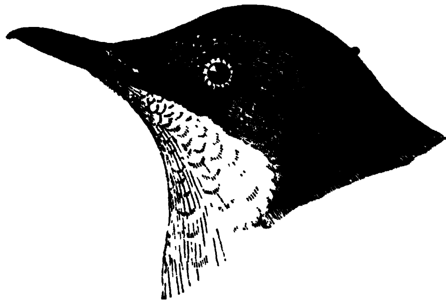


Fig. 240.—Head of the Water Ouzel (*Cinclus aquaticus*).

Only one genus of this group is found beyond the tropics, and this is remarkable both from its forming a complete transition to the true Thrushes, and from its singular habits. This is the genus *Cinclus*, to

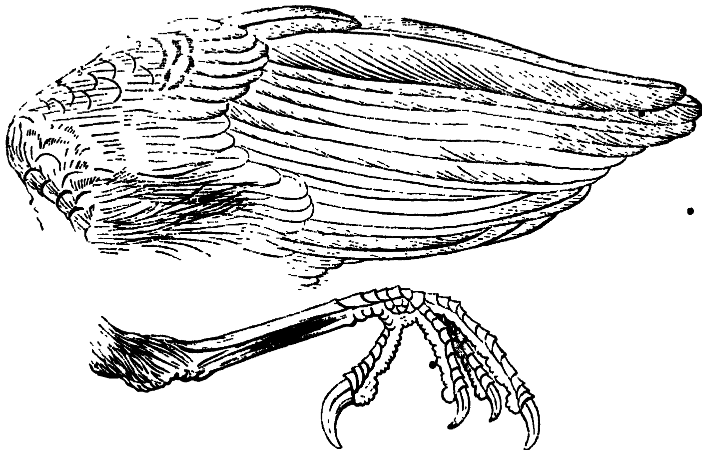


**Fig. 241.—Wing and foot of the Water Ouzel (*Cinclus aquaticus*).**

which the common Dipper, or Water Ouzel (*Cinclus aquaticus*, Fig. 240), of this

country belongs. This bird is about eight inches in length; the plumage of the upper parts are dark gray, that of the head and neck brown; the throat and fore part of the neck are white, and the breast brownish-red. The greater part of the front of the tarsi is covered by a single plate (Fig. 241). The wings are larger and more pointed than the majority of the birds in the group, indicating a more extended power of flight, and the Water Ouzel is described as shooting along steadily and rapidly.

The Dipper is always found in the immediate vicinity of water, especially on the banks of the clear streams and lakes of mountainous districts. This is the case with some of the other species of the group, but none, except the members of the genus *Circlus*, however close they may go to the margin, ever venture *into* the water. Our common Dipper, however,—and the other species of the genus, are said to have the same habits,—plunges into the water without the least hesitation, dives to the bottom with ease, and progresses in that remarkable situation with considerable rapidity. It was long asserted that the bird walked into the water, and having surrounded himself with a coating of air to serve in place of a diving-bell, proceeded deliberately to promenade the pebbly bottom. This, however, is evidently impossible, as the Dipper's feet are not formed for walking, even on land; and the lightness of its body would infallibly bring it to the surface if it attempted to hop there. According to Mr. Macgillivray the diving and progression under water is effected in much the same way as by many of the web-footed Natatorial birds, by the action of the wings, so that the bird may really be said to fly under water. In this manner it makes way even against a strong current, but evidently by dint of considerable exertion; and as soon as this is relaxed it rises to the surface like a cork. On coming up to the surface it swims with ease, or can dive again from that position without any necessity for visiting the shore. Its object in these sub-aquatic excursions is to procure its food, which consists of small aquatic mollusca and insects. To these articles of diet some authors add small fish and the spawn of fish; and from a belief that the Dippers destroy the ova of salmon and trout, they are in many places exposed to a considerable amount of persecution, although it appears rather uncertain whether they are really guilty of the offence imputed to them.

Their nests are formed of moss, firmly matted together, and are completely domed over, with only a hole in one side for the entrance and exit of the birds. Within this there is a second nest composed of grasses and lined with leaves. The nest is placed on the bank of the stream, sometimes amongst the roots of a tree, in a crevice of a rock, or in a hole in the brickwork of a bridge. The eggs are five or six in number, and of a pure white colour. The birds have two or even three broods in a season.

Only two or three other species of this interesting genus are known. They are inhabitants of different parts of the world, but their habits are described as very similar to those of the British bird.

The last family of the Dentirostral birds is that of the *Sylvidæ*, or Warblers. In these birds the bill is usually of moderate length, rather slender, generally broad at the base, and tapering towards the extremity, with the tip of the upper mandible more or less curved downwards, and slightly notched. The nostrils are situated at the base of the bill, in a membranous groove, with the opening uncovered; the wings are long, the tarsi usually long and slender, and the toes variable in length, the outer one united at the base.

This family includes a great number of species, most of which are fine songsters, whilst some are universally admired for the sprightliness of their actions. They are all small birds, and generally of sober colours, although many of them are of great beauty. They are divided into five sub-families, of four of which we have British representatives.

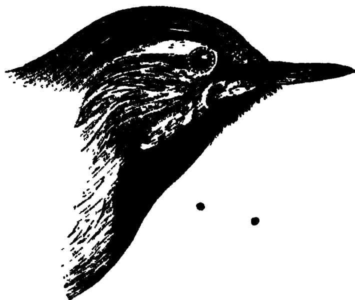


Fig. 242.—Head of the Gray Wagtail (*Motacilla Boarula*).

The first of these, the sub-family of the *Motacillinæ*, or Wagtails, exhibits a certain resemblance to the Larks, and, indeed, includes some species which have been placed with these birds by some authors. The Motacillinæ have the bill moderately long, straight, and slender, much compressed, with the ridge of the upper mandible straight to the tip, and then slightly curved; the tip of the upper mandible is notched. The wings (Fig. 243) are long and pointed; the secondaries are frequently notched at the end, and the tertiaries very long and pointed, a character in which these birds resemble the Larks. The tail is long, sometimes nearly twice the length



Fig. 243.—Wing of the Pied Wagtail (*Motacilla Yarrellii*).

of the body, and it is to the remarkable jerking motion of this organ, that these birds are indebted for their common name of Wagtails. The tarsi are long and slender, covered in front by about eight scales, of which, however, only the four lower ones are usually to be recognized distinctly; the toes are rather short, the outer one generally

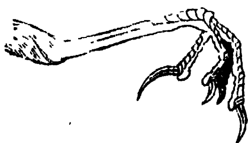


Fig. 244.—Foot of the Gray Wagtail (*Motacilla Boarula*).

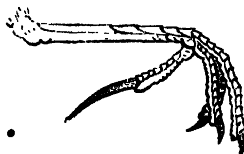


Fig. 245.—Foot of the Yellow Wagtail (*Budytes Rayi*).

longer than the inner, and slightly united at the base to the middle one, and all the toes are armed with slightly curved and acute claws, of which that on the hinder toe is sometimes very long. The Motacillinæ live in meadows and pastures, frequently by the sides of streams and pools of water; they run swiftly, and have an exceedingly

graceful, buoyant, rapid, and undulating flight. On alighting upon the ground, they usually spread the tail, and whilst running along, they are constantly vibrating the body and tail in a very singular manner. Their food consists entirely of insects. Their nests are made upon the ground amongst herbage or stones, and they lay from four to six spotted eggs.

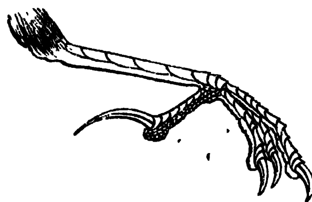


Fig. 246.—Foot of the Rock Pipit (*Anthus petrosus*).

These birds are found in both hemispheres, and are pretty generally distributed in all latitudes, but many of them migrate regularly from the temperate to the warmer parts of the world on the approach of winter, and the majority appear to change their residence more or less, according to the season. Nine species occur in Britain, three of which belong to the typical genus *Motacilla*. These are exceedingly elegant birds, of a slender form and very sprightly in their habits. They are found in abundance in moist meadows, and in the immediate vicinity of water, tripping lightly and gracefully along upon the sand or mud. Their note is short and shrill, and is frequently repeated as they run about in search of insects and little worms, which constitute their food. They are frequently seen to capture insects on the wing, in the manner of the Flycatchers. They also often wade in the shallow water.

The commonest British species is the Pied Wagtail (*Motacilla Yarrellii*, Fig. 247), which is elegantly varied with white and black, and which was until very recently



Fig. 247.—Head of the Pied Wagtail (*Motacilla Yarrellii*) in summer and winter plumage.

confounded with the White Wagtail of the European continent (*M. alba*). The latter, which is very abundant on the continent, is rare in this country, and our bird is equally uncommon in most parts of Europe. The Gray Wagtail (*M. boarula*, Fig. 242), is of a bluish-gray colour above, with the rump and the lower surface yellow; in the summer the throat has a black patch. These birds produce two broods of young in the course of the summer.

Two other British species, the *Budytes flava* and *B. Rayi*, stand in the same relation to each other as the Pied and White Wagtail above referred to,—the *Budytes Rayi* is

the common yellow Wagtail of this country, and was long supposed to be identical with the common species of the continent, but the two species have lately been found to be distinct. They resemble the *Motacillæ* in their habits.

The Pipits (*Anthus*) make a close approach to the true Larks, and are commonly known under the name of Titlarks. They closely resemble the true Wagtails in their habits, walking and running upon the ground in search of the insects which form the principal part of their food. They also feed upon seeds. The commonest species in this country is the Meadow Pipit or Titlark (*Anthus pratensis*, Fig. 248), which is found abundantly in all parts of the country, generally, as its name implies, in meadows; it is a permanent resident in Britain. Another species, the Shore or Rock Pipit (*A. petrosus*) frequents the sea-shore and follows the retreating tide, in company with the smaller Wading-birds, in search of small Mollusca and Crustacea. The Tree Pipit (*A. arboreus*), which is a summer visitor to these islands, inhabits wooded districts and perches upon trees to a much greater extent than its congeners. Its nest, however, like theirs, is made upon the ground.

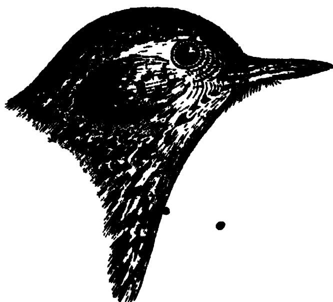


Fig. 248.—Head of the Titlark (*Anthus pratensis*).

The *Mniotiltinæ*, or Bush Creepers, form the second sub-family. They have a moderately long, acutely conical bill, with the ridge of the upper mandible nearly straight, and its tip slightly notched. The wings are long, and usually pointed, and the tail of moderate length: the tarsi, which are covered with scales in front, are usually longer than the middle toe, sometimes nearly twice as long, and the toes are long and slender, the outer one usually longer than the inner.

These birds are found in both hemispheres, principally in the warmer regions; but several of the species, especially the American ones, migrate from the warm to the more temperate climates. In their habits they appear to be very uniform, residing principally in thickets and woods, and feeding on insects, spiders, and worms. In search of insects and their larvæ, and spiders, these birds, which are usually of diminutive size, creep about upon the bushes with great agility, examining every leaf with great care, and even poking their heads into flowers to capture the minute insects which seek shelter amongst the petals. Thus Dr. Jerdon mentions that one of the common Indian species (*Zosterops palpebrosus*) is often seen with its forehead powdered with pollen, picked up during its inspection of flowers.

They are sociable little birds, generally keeping in small flocks, which are sometimes associated with those of other species of insectivorous birds. Some of them build on the ground, in the centre of a thicket of bushes, others in bushes and trees. The nest is sometimes arched over, with a small hole in the side for the entrance and exit of the birds, sometimes cup-shaped, and either placed in the fork of the branch of a tree or suspended upon the twigs. The same species sometimes appears to build in any of the three last mentioned positions; for the little *Zosterops palpebrosus*, already referred to, is said by Mr. Layard to construct its nest "in the fork of two branches," whilst Captain Hutton describes the bird as building in thick bushes of *Hibiscus*, or suspending its nest from the twigs of trees. He says the nest "is not

placed on a branch, but is suspended between two thin twigs, to which it is fastened by floss silk, torn from the cocoons of *Bombyx Huttoni* (Westwood), and by a few slender fibres of the bark of trees, or hair, according to circumstances. So slight and fragile is the little oval cup, that it is astonishing the mere weight of the parent bird does not bring it to the ground; and yet, within it, their young ones will safely outride a gale that will bring the weightier nests of Jays and Thrushes to the ground." These birds have no regular song, but merely a feeble twittering note, which is constantly emitted whilst they are engaged in their search for food.

The sub-family of the *Parinæ*, or Titmice, consists of a number of diminutive, sprightly birds, which are found in both hemispheres. In these birds the bill is short, straight, and tapering, with the upper mandible quite destitute of the usual notches at the tip. The nostrils are placed at the base of the bill, and usually concealed by the recurved feathers of the forehead. The wings are short, and the tail long; the tarsi rather long and slender, distinctly scutellated in front; the inner toe is the shortest, and all the toes are furnished with strong, curved claws.



Fig. 249.—Head of the Great Titmouse (*Parus major*).

These little birds, several species of which are well known in England under the names of Tits, Titmice, and Tom Tits, are active, lively, and courageous, and many of them are adorned with exceedingly beautiful colours. They are found principally in wooded countries, where they feed upon insects and larvæ, which they capture both upon the bark and leaves of the trees and shrubs. In search of these they may be seen clinging in every variety of attitude to the branches and twigs; and when thus engaged, from the sprightliness of their whole behaviour, they are exceedingly pleasing objects. They are often seen engaged in this manner in gardens, where they climb about the fruit-trees in every direction, and often destroy a good many buds in their search for insects contained in them.



Fig. 250.—Head of the Blue Titmouse (*Parus cæruleus*).

The Tits do not, however, confine themselves to insect food; they will readily peck at meat or even carrion, and Mr. Hepburn says he has seen the common Blue Tit (*Parus cæruleus*, Fig. 250) descend upon the meat exposed in a butcher's shop in the town of Haddington. The Great Tit (*Parus major*, Fig. 249), which is itself less than six inches in length, is said even to kill small birds by repeated blows upon the head with his sharp bill, afterwards pecking out and eating the brains of his victim. They also eat seeds of various kinds, especially during severe weather, when they generally approach the habitations of man to pick up any of the numerous fragments of food which are always to be found about houses.

These birds build their nests in various situations, sometimes on the branches of trees, sometimes in cavities in walls, or in the hollows of trees,—the latter they are said to enlarge for this purpose in the same way as the woodpeckers. The nests are usually formed of grass and moss, and lined with hair and feathers. The eggs are numerous, usually from six to eight; but the little Blue Tit lays sometimes as many as twelve eggs. During the period of incubation, and after the young are hatched, these diminutive creatures exhibit the greatest courage in defence of their progeny, attacking birds much larger than themselves whom they may suspect of nefarious designs. The female will sometimes remain on the nest until a person has introduced the hand, when she produces a hissing noise, and pecks at the intruder with great violence; in fact, Mr. Yarrell says that the boys in some counties give the name of Billy Biter to the Blue Tit, "from a vivid recollection of certain impressions made on their fingers."

Our British species are very generally distributed over the continent of Europe, and most of them are exceedingly common birds in this country. The only species that can be called rare in Britain is the Crested Tit (*Parus cristatus*), a beautiful little bird, in which the feathers of the crown are elongated so as to form a conical crest. The Long-tailed Tit (*Mecistura caudata*), which is also a common species, is rendered remarkable by the great length of its tail, which is at least twice as long as that of any other native species of the group.

One of the British species, the Bearded Tit (*Calamophilus biarmicus*), is remarkable from its constantly inhabiting the neighbourhood of water, living amongst the reeds and sedges of the margin. It feeds to a considerable extent upon the seeds of these plants, and its stomach forms a muscular gizzard which the true Tits do not possess; some authors have therefore proposed its removal amongst the Conirostral birds. It also eats insects, in search of which it climbs about upon the upright stems of the reeds with great facility, and a good deal of its food appears to consist of small shelled Mollusca, of the genera *Succinea* and *Pupa*, with which its crop has been found completely crammed. These are swallowed whole, but the shells are soon broken up by the action of the gizzard. The nest of this species is built amongst the thick herbage close to the ground, without being suspended.

The exotic species of this group closely resemble our British species in their habits; in warm climates they appear generally to prefer mountainous districts, some of the Indian species being commonly found at an elevation of more than seven thousand feet.



Fig. 251.—Head of the Whinchat (*Saxicola rubetra*).

In the sub-family of the *Erythacinæ* or Robins, the bill is rather short, slender, tapering, somewhat conical, and depressed at the base, with the ridge of the upper mandible nearly straight, slightly decurved at the tip, which is very indistinctly notched. The gape is more or less distinctly furnished with bristles. The nostrils are of an oblong form, placed in the anterior part of a membranous groove, the basal portion of which is feathered. The tarsi are usually long and slender, compressed and covered in front with a single long plate, in which, however, the divisions of the scutella are

often distinctly perceptible; and the toes are of moderate size (the hind toe and claw being usually the largest), covered with scutella and armed with rather large, curved, compressed, and acute claws.

The Robins are for the most part inhabitants of the Eastern Hemisphere, in all parts of which they occur. They feed principally upon insects and worms, for which they search in every direction, some seeking their food mostly upon the ground, amongst stones, fallen leaves, &c.; whilst others frequent woods, and find their insect prey upon the branches of trees and shrubs. Several of them often pursue insects on the wing. They also feed to a greater or less extent upon fruits, and even upon seeds; and in severe weather many of the species approach the abodes of man, and pick up indiscriminately any fragments of food that may fall in their way. Their nests are large, and carefully lined with soft materials; their eggs are generally of a pale-blue colour.

Nine species of this group have been found in Britain, of which three are permanent residents in this country, three visit us to pass the summer, and three are found here only as occasional visitors. The most familiarly-known of all the species,—the charming little Redbreast (*Erythacus rubecula*, Fig. 252),—belongs, as is well known, to the first-mentioned series; but in the more northern countries of Europe it is a summer visitor. It is a permanent resident in all temperate parts of Europe, and occurs in Asia Minor and the north of Africa. In all European countries it is a universal favourite, and its familiar names in most languages are expressive of the affection with which it is regarded. The principal cause of this is to be found in the boldness with which the Redbreast approaches human habitations; of all the small birds he certainly exhibits the least dread of man, and when a severe winter renders his chances of obtaining food in the open country rather precarious, he seems to lay aside all fear, and, with very little encouragement, will enter the cottage and pick up the crumbs, without appearing in the least discomposed by the presence of the cottager's family. The appearance of the Robin is also greatly in his favour; his air and movements are exceedingly sprightly, his eye is very beautiful, and when he ventures into close quarters with his human friends, he eyes them with a peculiar turn of the head, and a mixture of confidence and doubt in his whole aspect which are exceedingly amusing.

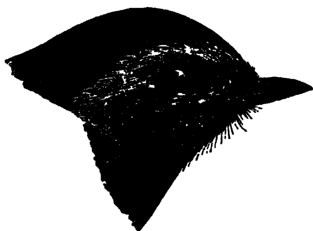


Fig. 252.—Head of the Redbreast (*Erythacus rubecula*).

This boldness and confidence in man attends the Robin even during the breeding season. In general the nest is built on a bank amongst bushes, or in a hole of a wall or decayed tree, but several instances are on record in which the birds have built and brought up their young in outbuildings, which were constantly visited by their owners; and during the completion of the Crystal Palace at Sydenham in 1854, several Robins lived in the interior of the building and made their nests in the holes of the large roots which were employed in the formation of the banks at the south end, notwithstanding the constant passing and repassing of the workmen, and the almost deafening noise that was continually going on. The nest is composed externally of moss, dead leaves, and dry grass, and lined with hair and occasionally feathers. The eggs are usually five or six in number, white, with pale reddish-brown spots.

As a general rule, and especially during the breeding season, the Robin is a most pugnacious little fellow, attacking and driving off all the small birds from the neighbourhood of his favourite resort. He has even been known to assault cats, when they have approached too near his home. He sings very sweetly, and according to White, through the whole of the spring, summer, and autumn. He is also said to sing even in dull, rainy weather, when almost all other song-birds are silent.

Another resident species is the Hedge Warbler or Hedge Sparrow (*Accentor modularis*, Fig. 253), an exceedingly abundant and generally distributed species, which is constantly found about hedgerows and in gardens. Like the Robin, this bird also approaches the houses in winter in search of food, and it appears to be a gentle and interesting little creature. It has none of the pugnacity of its red-breasted relative, and when the two come into collision, which is not unfrequently the case, the Hedge Sparrow is always forced to give way before his impetuous assailant. It builds its nest of green moss, fine roots, and wool, and lines it with hair, generally placing it low down in a bush or hedge. It is one of the first birds that builds in this country, its nest being generally completed early in March, and as the hedges at that season are usually bare of leaves the nest is very easily discovered and frequently becomes the booty of some birds'-nesting boy; indeed, as Mr. Knapp observes, the eggs of this bird are always found in such numbers on the strings of these young robbers that it is a wonder the species is not altogether extirpated. The eggs, which are usually four or five in number, are of a delicate greenish-blue colour, without any spots, and the birds generally rear two broods in the season. The song of the Hedge Sparrow is sweet, but weak and short, exhibiting very little variety,—it is continued nearly all the year round. A larger species, the Alpine Accentor (*Accentor alpinus*), which is common over a considerable portion of Southern Europe, has also occurred, but very rarely, in this country. It is terrestrial in its habits, passing the summer in high mountain districts, where it builds its nest amongst stones or in cavities of the rocks, and only descending into the valleys when the storms of winter render its longer sojourn in its elevated home impossible.

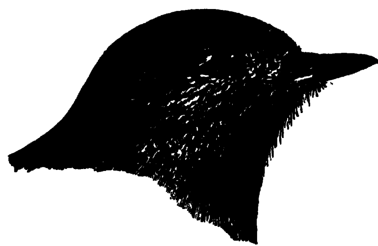


Fig. 253.—Head of the Hedge Sparrow (*Accentor modularis*).

The third resident British species of this group is the Stonechat (*Saxicola rubicola*), which, however, is a migratory bird on the continent of Europe. It is a rather smaller bird than the Robin, and is commonly found upon commons and heaths which are partially covered with furze or brushwood. It is in almost incessant motion, flitting about from one bush or stone to another, or perching upon some elevated part of a bush or stone, and dashing off like a Flycatcher to capture some passing insect, and then returning again to its former perch. When thus engaged these birds are very noisy, and from this the common name of Stonechat or Stonechatter is derived. They also possess a short but pleasing song. A very similar but migrating species is the Whinchat (*S. rubetra*). Its English name is derived from the great partiality which the bird evinces for furze bushes, which in many places are called *whin*. A third and larger species, the Wheatear (*S. œnanthe*, Fig. 254), is also a migratory bird, arriving in great numbers upon our southern coasts about the middle of March, and

leaving again for the south towards the end of September. Towards the end of July, the Wheatears begin to assemble in great numbers upon the downs of our southern coast; and as they are then in first-rate condition and greatly esteemed for the table, they are captured in immense quantities by the shepherds who attend to the numerous flocks in those districts. Some idea of the havoc made amongst these little birds during the months of August and September, may be obtained from the fact, that as many as eighty-four dozen have been taken by one shepherd in a day; and according to Pennant the number annually caught in the neighbourhood of Eastbourne, in Sussex, amouted to about 1840 dozen. The mode in which they are taken is singular from its simplicity. A chamber is formed by cutting out an oblong piece of turf, which is then laid over the hole formed in the opposite direction, so as to be supported by its ends; and two passages are also cut in the turf leading into the chamber. Through these the birds run for shelter at the least alarm; but in the middle of the chamber a small upright stick is placed supporting two running loops of horse-hair, so arranged that it is almost impossible for a bird to run through the chamber without getting his neck into one of the nooses. It is said that one shepherd, with the assistance of his lad, will attend to from five to seven hundred of these snares.



Fig. 254.—Head of the Wheatear (*Saxicola œnanthe*).

The other three British species of this group are the Redstarts (*Ruticilla*), of which, however, two are only occasional visitors to this country. The third, the common Redstart (*Ruticilla phœnicura*), is a regular summer visitor, but never occurs in great abundance. In its general habits this bird resembles the Redbreast, and feeds like it upon insects, worms, and fruits. The name of Redstart, applied to this bird, is in allusion to the red colour of its tail, and the constant jerking motions of this organ with which it accompanies its changes of position. The Redstart is particularly partial to walls, especially if old and covered with ivy. It often builds its nest in holes in such situations. It also breeds in the holes of trees, and not unfrequently on the ground. The eggs are usually from four to six in number, and of a uniform greenish-blue colour.

The exotic species of this group appear to be most abundant in Asia, and a great number are found in India. One of these, the *Kittacincla macroura*, is described as a most splendid songster, almost, if not quite, equal to the European Nightingale; in fact, it is denominated the Indian Nightingale by some naturalists. It inhabits the recesses of the forests, and, like the Nightingale, sings during the night. Mr. Blyth states that many thousands of these birds, which are called *Shámás* by the Bengalese, are kept in cages in Calcutta, and that it is the universal practice to darken their cages by wrapping them round with several folds of cloth, enough, as he observes, "to stifle the luckless captives in this climate, though, it must be confessed, they sing most vigorously while thus circumstanced." He adds, "It is a practice of the rich natives to employ servants to carry about their Shámás and other birds, and the number which are thus borne about the streets of Calcutta is astonishing; the poor

birds are shut out from all light and air, like Mahommedan ladies enjoying their evening drive, but they nevertheless sing forth most lustily and melodiously." Mr. Tickell also describes the song of the bird, when heard in its native forests, as wonderfully beautiful. He says, "The strains sweep with a gush of sweetness through the enchanting solitudes which this bird makes its favourite resort, at times when other birds are silent in rest; and in unison with the surrounding scenery, in which nature seems to have lavished every fantastic invention of beauty, the effect produced upon the mind and ear can alone be appreciated by those who have witnessed the magnificence of a tropical forest."

Another Indian species, which has a beautiful song, is the Dayal (*Copsychus saularis*), which, according to Mr. Layard, is called the Magpie Robin by the English residents in Ceylon, where it is regarded with the same interest accorded in Europe to its red-breasted relative. In India it is constantly caged, both for the sake of its song and for another quality, in the possession of which it also resembles our Robin, its pugnacity. Fighting the tame birds, according to Mr. Hodgson, is a favourite amusement of the rich; and he adds, that no game-cocks can contend with more energy and perseverance than these little birds. The same author states that the professional bird-keepers take advantage of this pugnacious disposition in their pets to make them instrumental in the capture of their wild brethren. During the spring it appears the male birds are continually challenging each other, and as soon as one has uttered his note of defiance it is answered by another, and these altercations usually end in a battle. The bird-keeper accordingly carries a tame male on his hand to the nearest garden or grove, when the bird at his bidding utters his challenge, and if this is answered by a wild bird, the tame one is immediately slipped, and a desperate combat commences, in the course of which the man easily secures the wild bird, the tame one actually assisting in the act, by holding his opponent with his bill and claws.

Another species, the *Thamnobia fulicata*, or Indian Robin, even exceeds his European representative in boldness and familiarity; it is always found about houses, which it frequently enters, and is a great favourite both with the natives and the European residents.

Of the few American species we need only notice the Blue Bird of the United States (*Sialia sialis*), which in its general form and habits closely resembles our own Robin, whose place he appears to take in the affections of the country people in America. The Blue Bird is essentially a summer bird in the United States, and in winter a considerable portion of the species appears to migrate southwards, as at this season it is very common in the West Indian Islands, and the tropical parts of America. That some do not undertake such a distant pilgrimage, however, is proved by the fact that a few generally make their appearance in their summer haunts whenever a few days of mild weather occur in the course of the winter. The song of the Blue Bird is described as being sweet and pleasing, and appears to be greatly admired in the States. It builds in the holes of trees and similar situations, and lays five or six eggs of a pale blue colour. Its food consists for the most part of insects and spiders, but occasionally, especially in the autumn, this diet is varied with fruits of different kinds.

The typical sub-family of the *Sylvinæ*, or True Warblers, presents a very close resemblance in its general characters to the preceding group. The bill is of the same form, but generally a little longer and less depressed at the base, and the notch in the upper mandible is usually rather more distinct. The nostrils are

basal, placed in a membranous groove, and frequently furnished with an opercular scale. The tarsi are rather long and slender, covered in front with distinct scales.

In their general form these birds are less robust than the Erythacinæ, which, however, they resemble in many respects. They are active, lively birds, which generally inhabit trees and bushes, where they seek for the insects which constitute their principal food. These they not unfrequently take on the wing in the manner of the Flycatchers. They also feed upon fruits, and some of the species also eat small seeds. Their nests are very neatly constructed, and generally cup-shaped; their eggs usually vary from five to eight in number, and they rear two broods in the season. They are generally gifted with great power of song, some of them, such as the celebrated European Nightingale (*Philomela luscinia*), being pre-eminent in this respect. Like the majority of insectivorous birds, those which occur in the temperate and colder climates are generally migratory in their habits, the English species, with the exception of two, arriving with us in the spring and leaving us again in the autumn for the more genial regions of the south. They are found in both hemispheres.



Fig. 255.—Head of the Nightingale (*Philomela luscinia*).

We shall be compelled only to notice a very few of the most remarkable of the numerous species belonging to this group, of which no less than fifteen have been recorded as British. And first amongst these we must refer to the Nightingale (*Philomela luscinia*, Fig. 256), which has been the theme of admiration with poets and writers of all classes from time immemorial, and is certainly the most celebrated of all song-birds. This bird, which, notwithstanding its beautiful notes, is perhaps as dingy and homely in its appearance as any of the inhabitants of the air, is a migratory bird in this country, where it arrives about the middle of April, and it is remarkable that the course of its migration appears to be in a direct line from south to north, for it is never heard in the most western parts of the kingdom (Wales and Cornwall), nor are any instances on record of its occurrence in Ireland. Its migration towards the north is also limited in a singular manner; in the eastern parts of England it is said never to proceed much further north than the city of York, whilst on the west it has been heard near Carlisle, and yet we have no reliable evidence of its occurrence even in the south of Scotland. This is the more remarkable, as on the European continent the Nightingale extends its migrations into Denmark, Sweden, and the corresponding portions of Russia.



Fig. 256.—Nightingale (*Philomela luscinia*).

From the moment of their arrival in this country, the males, which precede the

females by a few days, commence their song, and continue it until the young are hatched, which generally takes place in June. During the whole season of incubation the male sings at intervals during the day, and also serenades his mate in the night, when most other birds have retired to roost. It is probably to this habit of pouring forth his melody in the stillness of the night that this bird is indebted for some of his reputation, and there are not wanting some authors who have insinuated that several others of our native birds, if heard under the same circumstances, would be considered fully equal, if not superior, to the Nightingale. Nevertheless there is no doubt that whether by day or night the Nightingale is a most charming songster, and we can easily sympathize with the enthusiasm which prompted old Izaak Walton to express his admiration of the bird in the following quaint terms:—"But the Nightingale," says he, "another of my airy creatures, breathes such sweet loud music out of her little instrumental throat, that it might make mankind to think that miracles are not ceased. He that at midnight, when the very labourer sleeps securely, should hear, as I have very often, the clear airs, the sweet descants, the natural rising and falling, the doubling and redoubling of her voice, might well be lifted above earth, and say, 'Lord, what music hast thou provided for the saints in Heaven, when thou affordest bad men such music on earth.'"

The Nightingale frequents woods, plantations, and hedge-rows, and is by no means uncommon in the great market gardens in the vicinity of London. It appears to prefer damp localities. The nest is made of leaves, with a little grass or a few rushes; generally placed in a hollow on the ground, and lined with a few fine roots; but the whole is so loosely constructed that, according to Mr. Yarrell, it is necessary to tie it round several times with string before attempting to remove it from its position. The eggs are four or five in number, and of an olive-brown colour.

Great numbers of these birds are kept in confinement, and a good Nightingale fetches a high price. The bird-catchers are always on the look out for the arrival of these birds, as the males, if caught immediately, before they have paired, are far more likely to survive than if their capture is delayed until after they have provided themselves with partners; in fact, in the latter case, the birds usually languish and die. The bird-catchers sometimes put out the eyes of young Nightingales, taken from the nest, from an opinion that they sing better when thus deprived of the benefit of light; but there appears to be no reason to believe that this cruel practice has any effect upon the bird's vocal powers.

Another beautiful songster belonging to this group is the Blackcap (*Curruca atricapilla*, Fig. 257), which also arrives in this country in the beginning or middle of April. By many people the song of this bird is considered equal to that of the Nightingale, and there is no doubt that the Blackcap is one of the finest of our native song-birds. The male is readily distinguished by his jet black head, from which his ordinary name is derived. He is said to assist in the business of incubation to a greater extent than the males of most small birds, and, in some instances, has been observed to sing whilst thus occupied; in fact, a writer in the Magazine of Natural History states, that he has several times been

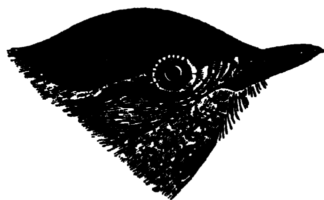


Fig. 257.—Head of the Blackcap (*Curruca atricapilla*).

guided to the nest of the Blackcap by hearing the male singing whilst sitting on the eggs. Like the Nightingale, this bird frequents woods, plantations, hedges, and gardens; but the nest, instead of being placed on the ground, is usually fixed in a bush, at a height of two or three feet,—it is formed of bents and dried herbage, and lined with fibrous roots and hair. The eggs are usually five in number, of a pale greenish-white colour, mottled and spotted with light and dark brown. Although shy in a state of nature, the Blackcap becomes familiar in confinement, and will take his food from the hand. This consists of insects and fruit, and the bird is said to be particularly fond of raspberries and currants.

Three species nearly allied to the Blackcap are also found in this country—they are the Garden Warbler (*Curruca hortensis*), the Whitethroat (*C. cinerea*), and the Lesser Whitethroat (*C. sylviella*). They all resemble the Blackcap in their habits, are lively and interesting birds, and possess a greater or less power of song, the first-mentioned species especially being a very pleasing songster.

The other British species have but little merit in their song, although it is frequently soft and agreeable. The Grasshopper Warbler (*Sibillatrix locustella*) is so called from the peculiar chirping note like that of a Cricket, which it is incessantly emitting. The genus *Calamodyta* includes some species which are always found amongst the reeds and sedges of the banks of rivers; and the nest of one of these, the Reed Warbler (*C. arundinacea*), is a very elegant, conical, cup-shaped structure, beautifully supported by the stems of three or four reeds, round which the materials of the nest are woven. The Dartford Warbler (*Melizophilus Dartfordiensis*), so called from its having been first discovered near Dartford in Kent, is noted for its great partiality to furze, whence it is called in some places the Furzeling or Furze Wren. It is one of our permanent residents, and makes a slight cup-shaped nest of dried herbage in the thickest parts of furze bushes. The birds of the genus *Sylvia* form their nests on the ground, constructing them of moss and grass, and covering them with a dome, so that the nest often presents the appearance of a large ball, with an opening on one side.



Fig. 258.—Head of the Golden-crested Wren (*Regulus cristatus*).

The little Golden-crested Wren or Kinglet (*Regulus cristatus*, Fig. 258), the most diminutive of our native birds, is also a member of this group. It is about three inches and a half in length, of a yellowish olive-green colour above and yellowish gray beneath; and the crown of the head is adorned with a beautiful orange-yellow crest, which is bordered on each side with black. This charming little bird is a permanent resident in this country, to which, indeed, it even appears to migrate in considerable numbers in the winter from the cold countries of the north of Europe. It is generally found in fir woods, and is exceedingly sociable in its habits, associating not only with its own species, but with several other insectivorous birds, such as the Tits (*Parinæ*) and Creepers (*Certhinæ*). In its manners it bears a very close resemblance to the Tits, exhibiting great liveliness, hopping from branch to branch, and clinging to the twigs in various positions, sometimes even back downwards, whilst searching for the small insects which constitute its principal food. Its nest is an elegant little cup-shaped structure of moss, frequently lined with feathers; it is suspended from three or four twigs of the fir trees, amongst which the bird generally lives, in such a manner that the branch serves to shelter the opening.

The female lays from six to ten eggs, and while sitting on them she is exceedingly bold, allowing herself to be looked at without quitting the nest. When the young are hatched she still retains her confidence; and Colonel Montagu found that on keeping a nest with eight young ones in a room the female tended them with great assiduity, whilst the male would not venture into the room. His partner, however, would feed the young ones whilst the nest was held in the hand; and the number of visits which she made to them in the course of the day was very extraordinary; she came once in a minute and a half or two minutes, or an average about thirty-six times in an hour; and this for fully sixteen hours in the day. The song of this little bird is soft and pleasing, not unlike that of the common Wren. Two other species of Kinglet have been found, but only occasionally in this country.

The habits of most of the exotic species of the group are very similar to those of the indigenous birds to which we have just alluded; but we must refer to the ingenious little Tailor Birds of the East Indies, whose nests are perhaps more singularly constructed than those of any other birds.

The Tailor Birds, which belong for the most part to the genera *Orthotomus* and *Prinia*, usually pick up the dead leaf of a tree and regularly sew it to a living leaf by the edges, thus forming a sort of pendulous pouch, which is of course supported by the foot-stalk of the leaf which is still attached to the parent tree. In some cases, however, they employ two contiguous living leaves. The thread employed in this operation is in some cases spun from raw cotton by the bird, in others common cotton thread is made use of, and some nests exhibit both these materials. The pouch thus formed is left open at the top, and the bottom is occupied by the nest itself, which is usually composed of cotton and flax, neatly woven together and lined with horse-hair. In these ingenious little cradles the Tailor Birds lay their eggs and bring up their young, secure, from the slenderness of their communication with the tree that supports them, from the attacks of the monkeys, snakes, and other enemies, who would otherwise frequently destroy their hopes. Their food consists of insects, which they capture either upon the bark and leaves of trees, or upon the ground. The *Drymoicæ* are also remarkable for the construction of their nests; they live in corn-fields, and amongst other tall graminaceous plants, the stems and leaves of which they sew together with threads formed of different materials. One of these birds, the *Drymoica cursitans*, is abundant in India; and another, the *Drymoica cysticola*, inhabits the south of Europe. The Tailor-birds, and *Drymoicæ*, belong to the sub-family *Maiurinæ* of Mr. G. R. Gray.



Fig. 259.—Nest of the Tailor-bird.

### SUB-ORDER III.—TENUIROSTRES.

**General Characters.**—In the group of Tenuirostral birds the bill is always slender, although very variable in its length and form, being sometimes perfectly straight and sometimes much curved. The tip of the upper mandible is usually entire and acute. The toes are elongated, especially the hinder one, and the outer toe is usually more or less united to the middle one at the base.

The leading character of these birds consists in the slenderness of the bill; but many of them certainly present an exceedingly close resemblance, even in the form of this organ, to the birds of the preceding section. Like them, also, their food consists principally of insects, which, however, they generally capture on plants and trees, rarely on the wing or on the ground. The majority are destitute of the peculiar arrangement of the lower larynx, by which the beautiful songs of the Dentirostral birds are produced.

**Divisions.**—This group may be divided into five great families. The first of these, the family of the *Certhidæ* or Creepers, includes a great variety of forms, and the characters by which it is circumscribed are exceedingly vague; it may, in fact, almost be regarded as a receptacle for all the Tenuirostral birds which will not enter any of the other families. The bill in these birds is more or less elongated, slender, and slightly arched; the tip of the upper mandible is acute, and usually entire; the nostrils are placed at the base of the bill, in a small groove, and covered by a membranous scale. In the form and structure of the wings and feet, these birds exhibit many varieties; but the legs are usually short, and the toes long and furnished with strong curved claws. The trachea in these birds is furnished with an apparatus for singing, and many of the species have a sweet song. The name of Creepers, given to these birds collectively, indicates the mode of life of most of the species; they seek their insect food by running about upon the trunks and branches of trees, very much in the manner of the Woodpeckers. With very few exceptions, they are all of small size.

Of the numerous sub-families into which the Certhidæ are divided, that of the *Troglodytinæ*, or Wrens, approaches most closely to the preceding sub-order; in fact, our common Wren has often been placed by the side of the Golden-crested Wren amongst the Sylvidæ. In these birds the tarsi are long and slender; the toes are long; the outer one longer than the inner, and slightly united to the middle toe at the base, the inner one being free. The bill is usually slightly curved, and the tip of the upper mandible is entire. The wings are short and rounded, and the tail, which varies considerably in length, is usually rounded at the extremity.

This group includes at once the largest and smallest members of the family—namely, the diminutive Wrens and the Australian Lyre birds, which in bulk, and to a certain extent also in appearance, approach the Gallinaceous birds. In their general habits the Troglodytinæ agree closely with the common Wren (*Troglodytes vulgaris*, Fig. 260), and a short description of the manners of this bird will consequently furnish a very fair notion of those of the rest of the group. This diminutive creature, one of the smallest of our British birds, as it measures only about four inches in length, is familiarly known to almost every one. It is an active, lively little bird, and appears to share with the Robin in the affections of country people. It frequents hedges, gardens, and bushy places, flitting from bush to bush with a direct flight, and feeding principally upon insects of various kinds, and also occasionally upon seeds and fruits. In spring and summer the male has a very sweet song, which is exceedingly loud and rich, especially when we consider the smallness of the pipe producing it.



Fig. 260.—Head of the Wren (*Troglodytes vulgaris*).

These birds are very familiar, constantly approaching the habitations of man, although they do not exhibit the same degree of confidence as the Robin, but generally conceal themselves very quickly when approached too closely. Nevertheless in the winter, when cold weather renders it somewhat difficult to keep up the vital heat in such a diminutive body, these birds often roost in cow houses, for the sake of the warmth generated by the cattle. Most of them, however, shelter themselves in holes at this season, roosting in considerable numbers together, so as to keep up the heat by close packing. For the same purpose they often frequent their nests of the preceding summer; and it has even been said by some authors that the male occupies himself while the female is sitting with preparing several nests, to afford shelter to the brood in the coming winter.

The Wrens pair about the middle of the spring, and early in April commence the construction of their nests. These are placed in very various situations, but principally in holes and crevices in walls, banks, and trees, and also in thatched roofs, amongst climbing plants, or even on the branch of a tree. The materials of which the nest is composed vary according to the situation in which it is built; thus, according to Montagu, "if built against the side of a hay-rick, it is composed of hay; if against the side of a tree covered with white moss, it is made of that material; and with green moss, if against a tree covered with the same, or in a bank." The nest is very large in proportion to the size of the architect; it is generally of an oval form, domed over at the top, and furnished with an opening either at one end or at the side. It is almost always lined with feathers. In this snug chamber the female usually lays from seven to ten eggs; but this number, according to some writers, is often greatly exceeded; and Mr. Macgillivray records instances of no less than sixteen and seventeen eggs being found in Wren's nests. The incubation occupies about ten days, during which the male frequently feeds his mate, and after the brood is hatched both parents are most assiduous in their attention to their young. According to some observations of Mr. Weir's, recorded by Macgillivray, a pair of these birds were seen to visit their nest of young with food no less than two hundred and seventy-eight times in the course of the day. They produce two broods in the season. The Wren is a permanent resident in this country, and indeed all over Europe; and is said to be more abundant in the northern parts of this continent than in the south.

The House Wren of the United States (*Troglodytes domestica*) appears to be far more familiar than our native species. It constantly frequents gardens, and builds about the houses, or in little boxes placed on purpose for it. It often selects curious places for the reception of its home; Wilson mentions one instance of a mower who had hung up his coat in a shed, and left it for two or three days, finding that the progress of his arm into the sleeve was interrupted by a mass of rubbish, which, on being extracted, proved to be a wren's nest completely finished, and ready for the reception of the eggs. The proprietors of the nest were by no means satisfied with this termination of their labours, but followed the destroyer for some distance, scolding him violently for his unwarrantable interference in their household affairs. The House Wren is said to be far superior as a songster to our European Wren. Like our Robin, the male is exceedingly pugnacious, and attacks without hesitation birds of twice his size, who appear inclined to trespass upon the domain which he has marked out for his own. In these contests he is generally victorious. He has also a very strong antipathy to cats. Two or three other species are found in the United States.

The most remarkable species belonging to this group are the Lyre-birds of

Australia, of which two species are now known, the *Menura superba* (Fig. 261), described more than fifty years ago by Davis, and a recently-discovered species described by Mr. Gould under the name of *Menura Alberti*. The common Lyre-bird (*Menura superba*) has been arranged with very different groups by different authors, some placing it with the Gallinaceous birds, its apparent relation to which is shown by



Fig. 261.—Lyre-birds (*Menura superba*).

the name Wood Pheasant sometimes given to it; others with the Hornbills and the Hoazin amongst the Conirostres; and others, again, in the neighbourhood of the Thrushes. It appears, however, to be most nearly allied to the diminutive birds of the present sub-family.

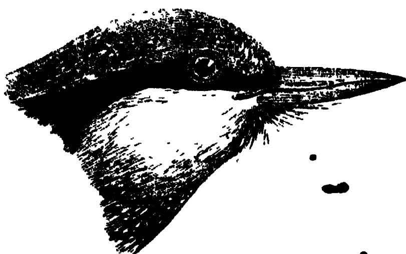
This singular bird is about the size of a Pheasant, and entirely of a dull grayish-brown colour; but it is rendered very remarkable by the structure of the feathers of

the tail in the male. These are very long, and of three kinds. Twelve of them are furnished with slender distant barbs, which give them an exceedingly light appearance; two others, placed in the middle of the tail, are furnished with short close barbs only on one side, whilst the most striking feature of all is formed by the two external quill feathers, which are very broad and curved into the form of an elongated S, so arranged as to present a close resemblance in outline to the lyre of the ancients.

The bird is supported upon long and tolerably strong legs, terminated by feet which, except for the absence of membranes at the base of the toes, might easily be mistaken for those of a Gallinaceous bird; and the Lyre-bird runs upon the ground with great facility, and, in fact, in many of its habits bears no inconsiderable resemblance to many of the Rasores. In other respects, however, it differs very widely from these. Its nest is a neat domed structure, composed of mosses, roots, and stems of plants; and when it is approached pretty closely, which, from its extreme shyness, is by no means an easy matter, it is found to possess a varied song. Both the species are found principally in the rocky gullies of New South Wales, where they run through the bush with such swiftness that, according to Mr. Gould, they are the most difficult to procure of all the birds of Australia. They fly but little, their wings being very short and rounded.

The *Sittinæ*, or Nuthatches, have the toes very long and slender, furnished with long, compressed, curved claws: the outer toe is longer than the inner one, and united to the middle toe as far as the first joint; the inner toe is also slightly united at the base.

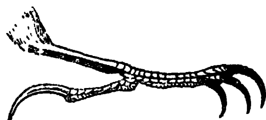
The little birds composing this small group are found principally in the Eastern Hemisphere, but some occur in North America, and a few in the forests of the western coasts of South America. The best known species is the European Nuthatch (*Sitta Europæa*, Fig. 262), a small bird, rather more than five inches and a half in length, which occurs, although not very abundantly, in many parts of this country. The Nuthatch is of a stout form; the general colour of the upper parts is a bluish-gray, of the lower parts light reddish-yellow, with the sides brownish and the throat and cheeks white; from the base of the bill to the shoulders there runs a black streak. It is a lively little bird, which lives principally in woods, and runs upon the trunks and branches of trees in search of the insects which conceal themselves in the crevices of the bark. This it is enabled to do by the great length and acuteness of its curved claws, and it is remarkable that it descends the trees head foremost, a most unusual proceeding, in which the powerful hind toe must be of great service. Besides insects it feeds on the kernels of nuts, and even of chestnuts, which it fixes in some convenient crevice and then breaks by hammering at them with its bill. In this operation the nut not unfrequently slips out of the crevice in which it has been wedged, when, according to the Rev. W. T. Bree, the Nuthatch will catch it before it reaches the ground.


Fig. 262.—Head of the Nuthatch (*Sitta Europæa*).

The Nuthatch breeds in the holes of trees, very frequently selecting the deserted hole of a Woodpecker for this purpose. Montagu states that "this hole is first con-

tracted by a plaster of clay, leaving only sufficient room for itself to pass in and out. The nest is made of dead leaves, most times those of the oak, which are heaped together without much order. The eggs are six or seven in number, white, spotted with rust-colour, so exactly like those of the Greater Titmouse in size and markings that it is impossible to distinguish a difference. If the barrier of plaster at the entrance is destroyed when they have eggs, it is speedily replaced; a peculiar instinct to prevent their nest being destroyed by the Woodpecker and other birds of a superior size who build in the same situation. No persecution will force this little bird from its habitation when sitting; it defends its nest to the last extremity, strikes the invader with its bill and wings, and makes a hissing noise; and after every effort of defence, will suffer itself to be taken in the hand rather than quit." A second species of Nuthatch has been found in Europe, and the United States of America are inhabited by several species, but their habits appear to be very similar to those of the common bird. None of them possess any song.

The *Certhinæ*, or True Creepers are distinguished by having the toes very long and slender; the outer toe, which is longer than the inner one, united to the middle toe beyond the first joint, and the inner one as far as the first joint. The hind toe is very long and slender, and all the claws are long, much compressed, and curved. The bill is usually very slender, and considerably curved; the wings are long and rather rounded, and the tail is usually pretty long. The toes in many cases exhibit an extraordinary degree of mobility; the hind toe may be placed at right angles to its ordinary position, and all the toes may be twisted so as to reverse the position of the claws. This arrangement is of great service to the birds in their continual running upon the bark of trees, on which, like the birds of the preceding groups, they search for the insects which constitute their principal food. The species are not numerous, but they occur in both hemispheres, although the greater part of them are inhabitants of the Old World. One species is found in this country—the Brown Creeper (*Certhia familiaris*, Fig. 265). It is a very small bird, measuring only about five inches and a half in length, including the tail, which is rather elongated. In running upon the trees it supports itself by the tail in the same way as the Woodpeckers, and the quill-feathers of this organ are accordingly stiff and pointed at the extremity (Fig. 266). The bird is generally distributed over this country and the continent of Europe, and also occurs in North America. It frequents woods and makes its nests in hollow trees, constructing


Fig. 263.—Foot of the Brown Creeper (*Certhia familiaris*).

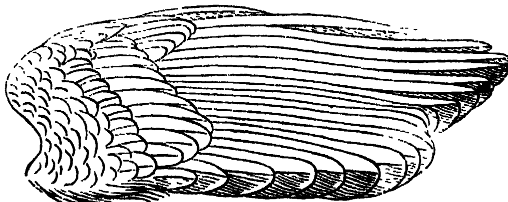

Fig. 264.—Wing of the Brown Creeper.


Fig. 265.—Head of Brown Creeper (*Certhia familiaris*).

it of small twigs and grass, and lining it with wool and feathers. It breeds early, usually in the month of April, and lays from seven to nine eggs. Its song is said to be pleasing, and not unlike that of the Golden-crested Wren.

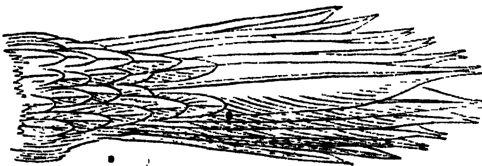


Fig. 266.—Tail of the Brown Creeper.

A second European species, the *Tichodroma muraria*, or Wall Creeper, seeks its insect food upon rocks and old walls, to which it clings in the same way the common Creepers do to the trunks of trees. It breeds in clefts and holes in the rocks and walls which it ordinarily frequents. It is found only in the South of Europe, and always upon the highest mountains.

The remainder of this family is composed of three groups of small birds, which are confined to the tropical portions of America. Of these the *Dendrocolaptinæ*, or Tree Creepers, appear to take the place of the common Creepers in the vast forests of the South American continent. They closely resemble the European Creeper in their habits, running upon the trunks and branches of trees in search of insects, which they find in the crevices of the bark. In these birds the outer toe is longer than the middle one, to which it is united for some distance from the base; the inner toe is short and slightly united; the hind toe is very long; and all the claws are long, compressed, curved, and acute (Fig. 267).

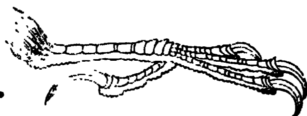


Fig. 267.—Foot of Dendrocolaptes.

The structure of the tail is remarkable from its adaptation to the climbing habits of the animal; it is long and broad, with the feathers stiff and pointed, and in many cases the shafts of the feathers project beyond the webs. The form of the bill is exceedingly variable, this organ being sometimes about the length of the head, and but slightly curved; sometimes twice this length and curved at the extremity, and occasionally very long and slender, and strongly arched throughout. Examples of the two extremes are here represented (Fig. 268). The tip of the upper mandible is always entire.

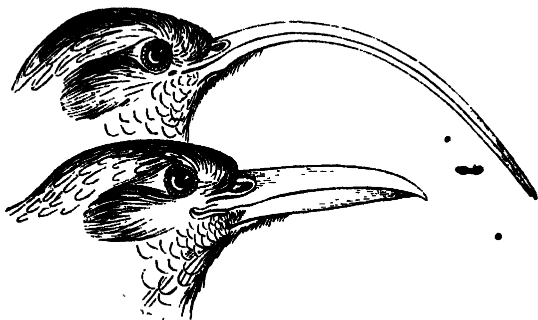


Fig. 268.—Heads of two species of Dendrocolaptinæ. *a* Dendrocolaptes. *b* Xiphorhynchus.

The tail feathers are also frequently pointed in another sub-family, that of the *Synallaxinæ*, in which the outer toe is longer than the inner one, and united to the middle toe nearly as far as the first joint. The inner toe is slightly united at the base,

the hind toe is long and strong, and the claws are strong and curved. The bill is not very long, slender, compressed, and pointed; and the tail is usually long and pointed. These birds are found, like the Dendrocolaptinæ, only in the forests of tropical America, where they capture insects upon the trees and bushes, and frequently also visit the ground in search of worms, small snails, &c. They are remarkable for the large size of their nests, that of one species measuring three or four feet in length. It is placed in low trees or bushes, and composed externally of small sticks, so that at a little distance it looks like a twisted mass of stalks which has been accidentally thrown into this position. Internally it is divided by a partition into two chambers, one of which serves as an entrance-hall, the eggs being laid upon a lining of feathers in the inner one.

The last sub-family is that of the *Furnarinæ* or Oven-birds, in which the outer toe is but little longer than the inner, and only slightly united at the base; the inner toe is entirely free. This group of small birds is very generally distributed over the continent of South America, and some species occur in the West Indian Islands. In their general habits the species resemble the Synallaxinæ, seeking their food, which consists principally of insects, both upon trees and bushes and on the ground, where they run and walk with great ease. They also occasionally feed on seeds. The species of the genus *Cinclodes*, inhabiting the west coast of South America, frequent the sea-shore, where they feed partly on small crabs and mollusca. Mr. Darwin says they are sometimes seen on the floating leaves of the *Fucus giganteus*, at some distance from the shore. A species of this genus, described by Lesson under the name of *Furnarius fuliginosus*, is said to be so tame that it may be almost touched by the hand; and Pernetty, a French voyager, states that it will almost come and perch upon the finger: he adds, that in less than half-an hour he had killed ten of them with a little stick, and almost without changing his position.

The typical *Furnarii*, to which the name of Oven-birds is properly applied, build a very remarkable nest. It is constructed of clay, straw, and dried herbage of different kinds, in the form of an oven, about six or eight inches in diameter, and with walls about an inch thick. The entrance is placed on one side, and the interior is divided into two chambers by a partition, the eggs being laid in the inner one. This curious nest is usually placed in a very exposed situation,—as, for instance, on the branch of a tree or the top of a paling.

In the second family of Tenuirostral birds, the *Meliphagidæ* or Honey-eaters, the bill is rather long, curved, acute, and slightly notched at the tip; the nostrils are placed in a large groove; the wings have the first three quills graduated; the tail is long and broad; the tarsi short and stout; and the toes elongated, with the outer one always united to the middle toe at the base. The tongue is long, protrusible, and terminated by a little tuft or pencil of fibres, which are of great service to the bird in extracting the nectar of flowers. They are usually destitute of any song.

These small birds are for the most part peculiar to Australia, but some species are found in New Zealand, New Guinea, and the adjacent islands. The habits of all the species are very uniform. They frequent the flowering shrubs and trees (*Eucalypti* especially), visiting the flowers for the sake of the pollen and the nectareous juices secreted by them, and also in search of the small insects which are attracted to the same situation by the same cause. Some of the larger species also feed upon fruits. Their nests are sometimes made in bushes, sometimes suspended from the extremities of slender twigs. They generally lay two eggs.

Mr. G. R. Gray divides these birds into three sub-families. In one of these, the *Melithreptinæ*, the bill is short and conical, acute at the tip, with the ridge of the upper mandible slightly curved and its tip usually notched; and the wings are rather long, the fourth to the seventh quills being generally longest. These birds are confined to the Australian continent.

In the two other groups the bill is long, slender, curved, and acute, with the tip of the upper mandible slightly notched. Of these, the typical sub-family of the *Meliphaginæ* is distinguished by having the wings rounded, the fourth, fifth, and sixth quills being the longest.

These birds are found in all the localities above-mentioned, and several of the New Zealand species are considerably larger than the ordinary run of the birds of this family. One of these, the *Prosthemadera Novæ Zelandiæ*, the Poe Bird, or *Tui* of New Zealand, is about the size of a Thrush, of a fine, glossy, black colour, with two small tufts of white feathers hanging down upon the sides of the neck. These white tufts have been compared to a pair of clerical bands, and taken in conjunction with the black plumage of the rest of the body, have obtained for the *Prosthemadera* the name of the Parson Bird. It is a fine songster, and imitates every sound that reaches its ear, even learning to speak with great ease and fluency. It is exceedingly lively and restless, and feeds principally upon flies and small insects, which it is exceedingly expert in catching. It also eats worms and fruits. Its flesh is said to be delicious.

Another species peculiar to New Zealand is the *Pogonornis cincta*, which is remarkable for the great length of the tufts of feathers over the ears; these are erected when the bird is alarmed, and give it a very singular appearance.

A remarkable Australian species is the Friar Bird (*Tropidorhynchus corniculatus*), which has the head and neck bare of feathers, and a curious tubercle at the base of the bill. Its voice is loud and very singular, some of its notes having a certain degree of resemblance to particular words, and several of its colonial names, such as Poor soldier, Pimlico, and Four o'clock, have been derived from these notes. Its name of Friar-bird alludes to its bare head, and the same character has obtained for it the denominations of the Monk and the Leather-head.

Our illustrations, derived from the magnificent work on the Birds of Australia, by Mr. Gould, give representations of two common Australian species of this group, the New Holland Honey-eater (*Meliphaga Novæ Hollandiæ*, Fig. 269), and the Wattled Honey-eater, or Brush Wattle bird (*Anthochæra carunculata*, Fig. 270). The latter bird frequents the Banksias, when these are in flower, and as the occurrence of these trees is a sign that the land is not good for much, Mr. Gould observes that the note of the Wattle-bird may warn the settler from making a barren purchase. This note is described as very harsh and disagreeable, resembling the noise made by a person vomiting; the native name, *Goo-gwar-ruck*, is said to be an imitation of it.

The third sub-family, that of the *Myzomelinæ*, or Honey-creepers, is distinguished from the preceding by having the third and fourth quills longest. In their habits and mode of life they resemble the true Honey-eaters.

From the Honey-eaters we pass by an easy transition to the little gem-like Humming-birds (*Trochilidæ*), the smallest and the most gorgeous of all the feathered creation. In these birds the bill is always long and slender, sometimes straight, sometimes curved and acute at the tip; the lateral margins of the upper mandible are usually dilated beyond those of the lower one. The nostrils are placed at the base of the bill, and covered by a large scale, which is sometimes clothed with feathers. The wings are long and

pointed, the tarsi very short and slender, and the toes long. The structure of the tongue in these birds is very remarkable. It is cleft nearly to the base, and the hyoid bone is prolonged round the skull in the same manner as in the Woodpeckers, so that the tongue works in the tubular bill like the sucker of a pump, and in this manner the little creatures suck up the juices of the flowers upon which they certainly subsist



Fig. 269.—New Holland Honey-eater (*Meliphaga Novæ Hollandiæ*).

to a certain extent. The sternum is very large, furnished with a deep keel, and quite destitute of notches, resembling in these particulars the sternum of the Swifts; and as this resemblance extends to all parts of the organs of flight, the Humming-birds and Swifts have been placed in juxtaposition by some authors.

In his work on the "Genera of Birds," Mr. G. R. Gray established three sub-families in this group; but as he has since amalgamated the whole into a single group, and the differences upon which the three sub-families were founded are really of comparatively little importance, it will be unnecessary for us to enter upon their distinctive characters.

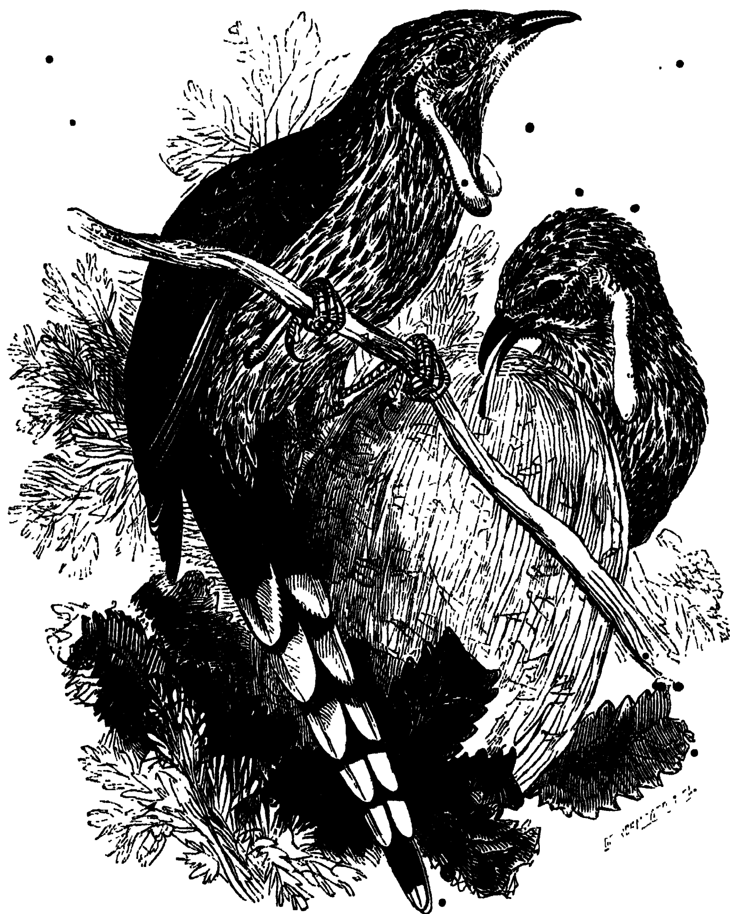


Fig. 270.—The Wattled Honey-eater of Australia (Male and Female) (*Anthochæra carunculata.*)

These charming little creatures, the most diminutive and elegant of all birds, are confined to the American continent and islands, and principally to the tropical parts, although it is remarkable that the most brilliantly coloured species are not, as might have been expected, found in the hot plains of Brazil, but at very great elevations upon

the mountains. Their power of flight is exceedingly great, as indeed is shown at once by the length and form of the wings, and the structure of the sternum, and they pass the greater part of their time on the wing, flitting, like many insects, from flower to flower, inserting their long slender bills into the nectaries in search of the juices secreted there, and the small insects which also find a home and sustenance amongst the delicate petals. It has indeed been denied that the Humming-birds take any nourishment except the honey of flowers; but this opinion is contradicted by the fact that insects are always found in their stomachs; and the upholders of the insect diet of these birds have, in their turn, disputed the fact of their ever sucking up the nectar. It seems probable, however, that their nourishment is derived both from these sources. M. Deville considers that their food consists principally of insects, and states that one species, the *Trochilus strumarius*, catches flies in the same manner as the Flycatchers, perching on the tip of a dead branch, darting off in pursuit of its prey, and returning constantly to its perch after having effected the capture.



Fig. 271.—Humming-bird (*Trochilus*).

They are exceedingly bold and pugnacious, often quarrelling amongst themselves for the possession of a particular flower, and the males rarely meet without a contest. They will also attack and frequently defeat other birds of much greater bulk; and an old French writer (Charlevoix) tells his readers that the Ruby-throated Humming-bird, to which we shall hereafter refer, was able to transfix even a crow with his slender bill, so as to bring the giant to the earth.

The nests of these little birds are, as might be expected from the size of the birds, very delicate in their construction, especially as they never lay more than two eggs. The nests are built in various situations, and of very different materials, as will be seen from the following remarks by Mr. Gould, from the proceedings of the Zoological Society. That gentleman states, that "most of the nests are cup-shaped, some being placed in forks, some on branches, some on leaves, and some in ferns; they are shallow and delicately formed, ornamented in the most varied manner with feathers, or with festoons of moss and lichen. The attachment of the lichen and other ornaments is effected by means of fine cobwebs." He adds, that "the Hermit-birds (*Phaëthornis*) invariably build at the extremity of leaves, perhaps from the protection which that situation affords against the attacks of monkeys and other predatory animals. *Oreotrochilus* builds a beautiful nest, attached to the sides of rocks. *Heliomaster mesoleucus* makes a nest in a beautiful species of moss, depending from the trees." The eggs, with but one supposed exception, are always of a white colour.

Of the numerous species arranged in this family we shall only notice a few. One of the most beautiful species is the Long-tailed Emerald Humming-bird (*Trochilus polytmus*), the male of which is furnished with a most elegant forked tail, the two outer feathers being greatly prolonged and very slender. The whole length of the

bird is a little more than ten inches, but about seven inches and a half of this is made up by the elongated feathers just mentioned. The head and the back of the neck of this little gem are deep velvet-like black; the whole of the back, with the wing and tail coverts golden green; the wings and tail are purplish or bluish black. The entire lower surface of the body is of a most gorgeous emerald green colour, except the neighbourhood of the vent and lower tail coverts, which are black. The bill is bright red, tipped with black, and the feathers of the back of the head are elongated, forming a sort of crest, which can be erected to a certain extent. Mr. Gosse, who has denominated this species "the gem of American ornithology," gives the following account of its appearance in a state of nature, in his interesting work entitled "A Naturalist's Sojourn in Jamaica." "While I was up in a calabash tree," he says, "the beautiful long-tailed Humming-bird came shooting by with its two long velvet-black feathers fluttering like streamers behind it, and began to suck at the blossoms of the tree in which I was. Quite regardless of my presence, consciously secure in its power of wing, the lovely little gem hovered around the trunk, and threaded the branches, now probing here, now there, its cloudy wings on each side vibrating with a noise like that of a spinning-wheel, and its emerald breast for a moment flashing brilliantly in the sun's ray; then apparently black, all the light being absorbed; then, as it slightly turned, becoming a dark olive; then in an instant blazing forth again with emerald effulgence. Several times it came close to me, as I sat motionless with delight, and holding my breath for fear of alarming it and driving it away; it seemed almost worth a voyage across the sea to behold so radiant a creature in all the wildness of its native freedom."

Another charming species is the Ruby-throated Humming-bird (*Trochilus colubris*), which measures about three inches and a half in length, and has the chin and throat of a most brilliant ruby red colour. The plumage of the back is golden green, and that of the lower surface whitish; the wings and tail are purplish-brown. This beautiful little bird is remarkable from the great extent of country over which it is distributed; instead of being confined, like most of its brethren, to the tropics, it wanders during the summer over the whole continent of North America as far as the fifty-seventh degree of latitude, in the territories of the Hudson's Bay Company.

The smallest species is the *Mellisuga minima*, a native of South America and the West Indian Islands, which measures only an inch and a quarter in length, and is consequently not larger than many of the Bees, and much smaller than some of the Moths, which dispute with it the right of searching its favourite flowers. Its general colours are the same as in the Ruby-throated Humming-bird, but it wants the beautiful red throat of that species.

A fourth family is formed by the *Promeropidæ*, or Sun Birds, which have the bill elongated, slender and usually curved throughout its length; the nostrils placed at the base of the bill and covered by a scale; the wings of moderate size, and the tarsi short and covered with broad scales. The Promeropidæ are generally magnificent birds, which inhabit the tropical regions of both hemispheres. They form two sub-families, one of which is confined to the Old and the other to the New World.

The former, which includes by far the greater number of the species, is the typical sub-family of the *Promeropinæ*, or True Sun birds. In these birds the bill is long, slender, curved and acute at the tip, sometimes finely serrated on the margins; the nostrils are closed by a membranous scale; the tail is usually elongated, and the central feathers are sometimes prolonged beyond the rest. The Promeropinæ are principally

found in the islands of the Eastern Archipelago and in India, a few species also inhabit Africa, but none occur in the temperate regions.

These birds appear to take the place of the Humming-birds in the Eastern Hemisphere; they rival even those living gems in the brilliancy of their colours, and their habits are very similar. In the morning and evening they are constantly seen in great numbers in the neighbourhood of flowers, into which they thrust their slender bills in search of the minute insects always found in such situations; they will also pick small spiders from their webs, and insects from the crevices of the wall and trees. They are said also to subsist partly on the juices of flowers, whence the name of *Sucriers*, or Sugar Birds, applied to them by some French authors. Some of these also feed upon fruits, and Mr. Layard states that a Ceylonese species, delights in the white viscid berries of a plant allied to the Misseltoe. Like the Humming-birds they are exceedingly quarrelsome, fighting violently for the possession of a flower, the vanquished bird retreating from the spot with shrill cries, whilst the conqueror takes up his position upon a flower or stem, and swinging his little body to and fro, pours out a note of triumph. The song is said to be very agreeable.

The nests of two species (*Nectarinia Lotenia* and *N. Asiatica*) are described by Mr. Layard. They are elegant domed structures, generally suspended from the extremity of a twig of some low bush, and artfully covered with cobweb. In this, Mr. Layard says, he has often seen the spider still weaving her toils, thus rendering the deception still more effective; and it would seem that the birds were aware of it, and left their helper undisturbed. The entrance to the nest is usually turned towards the interior of the bush, and is sheltered from the sun and rain by a sort of portico, which often projects more than an inch from the walls. In this snug tenement the little Sun-birds lay from two to four eggs, which are of a whitish colour, closely covered with minute dusky spots, so that their general colour appears gray.

The *Cærebinæ*, or Guitguits, the American representatives of the Sun-birds, have the bill straight or but slightly curved, conical and acute, with the base broad and more or less triangular; the tip of the upper mandible is finely notched. The nostrils are covered by a hard scale, and the wings are rather elongated and pointed.

These birds are found in tropical South America and the West Indian Islands. They closely resemble the Promeropinæ in their habits, deriving the principal portion of their sustenance from the small insects which they find in flowers. Like the former, they are also said to feed upon honey. Their plumage is exceedingly beautiful in colour, but wants the metallic brilliancy of that of the Humming-birds and Sun-birds. Their nests are of various forms, and built in different situations. Some species suspend their nests from the extremities of twigs, and these pendulous dwellings are sometimes furnished with a long funnel, through which the bird enters the nest; other species make the nest in a bush or tree, and in this case it is usually divided into two compartments, of which the outer serves as a vestibule, whilst the eggs are laid in the inner one, and are thus protected from the attacks of their enemies.

The sub-order of the Tenuirostral birds is completed by the family of the *Upupidæ*, or Hoopoes, which includes only a few species, all inhabitants of the Eastern Hemisphere. In these birds the bill is long and slender, slightly curved throughout, and with the tip acute and entire; the nostrils are small; the wings rounded; the tail long, and either rounded or even; the tarsi short and stout; and the toes long and strong, the outer one united to the middle toe at the base. The claws are strong and curved, and that of the hind toe is particularly powerful.

In the sub-family of the *Upupinæ* or Hoopoes, the nostrils are covered with a membranous scale, the wings are long and the bill is keeled at the base. The crown of the head is surmounted by an elegant crest of feathers, which can be raised at the pleasure of the bird (Fig. 198).

Although the species belonging to this group are very few in number, they enjoy a very wide distribution. Thus, the common European species (*Upupa epops*, Fig. 272), is found not only in Europe, where it is a bird of passage, but also in all parts of the continent of Africa; and is apparently very generally diffused over the Asiatic continent. This bird, which occurs by no means rarely in this country, especially in the southern counties, is of an exceedingly elegant appearance; it is about the size of the Missel Thrush (twelve inches in length), the head and neck are of a pale red colour; the fore part of the back is light purplish-red, and behind this it is of a reddish-white colour, barred with black; the wings are black, with several irregular white bars, and the tail is black with a single white bar. The crest is very elegant, being composed of long feathers, each of which is tipped with black.

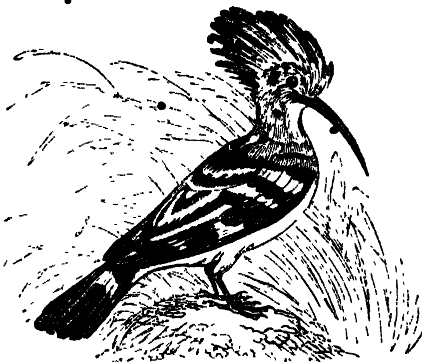


Fig. 272.—The Hoopoe (*Upupa epops*).

Although these birds perform a regular summer migration, proceeding even as far north as Denmark and Sweden, it does not appear generally to visit this country for the purpose of breeding, as, according to Mr. Yarrell, it usually occurs here in the autumn, after the breeding season is over. Instances have, however, occurred of the Hoopoe breeding in this country. They build in the holes of trees, forming the nest of a few stalks of grass and feathers, and the eggs are usually from five to six in number, and of a pale lavender-gray colour.

They inhabit the neighbourhood of woods, generally in marshy places, and seek their food—which consists of insects and worms—principally upon the ground, where they walk and run with great ease. They also frequently visit trees in search of food; and in the neighbourhood of Bordeaux they are said to be very abundant in some marshy ground, on which numerous pollard trees are grown for the sake of the twigs, the rotten summits of the trunks of these furnishing them with an abundant supply of insects, amongst which ants appear to predominate. In captivity, they are said to be readily tamed, and very amusing. Their note resembles the word *hoop*, pronounced very softly and repeated rapidly, and from this the common English name of the bird is derived. The French name, *huppe*, is particularly applicable, as it not only recals the note of the bird, but also refers to its most striking peculiarity, the elegant crest which adorns its head.

The sub-family of the *Epimachinæ*, or Plumed Birds, approaches the Birds of Paradise in some respects, and some of the species have been described as belonging to the Paradiseidæ. Like these, the Epimachinæ have the nostrils partly clothed with

velvet-like plumes, and placed in a broad basal groove; the wings are short, the tarsi rather long, and the toes long and strong.

The species are very few, and almost confined to New Guinea and the adjacent islands; one species is found in New Zealand, and two in Australia. They are exceedingly beautiful birds, some of them rivalling the Birds of Paradise in the splendour of their plumage, and some of the species are also furnished with long plumes similar to the well-known ornaments of the Birds of Paradise. The species here figured (*Epimachus albus*, Fig. 273) is of a fine metallic violet-black colour, with a broad collar of feathers margined with emerald green at the base of the neck. The plumes spring from the back and rump; they are of a white colour, and very long, with long, silky, distant barbs, and twelve of the lower plumes are terminated by long filiform continuations of the shafts, which are curved and blackish towards the extremity; these formerly obtained for the bird the name of the Twelve-threaded Bird of Paradise.



Fig. 273.—Epimachus albus.

The Australian Rifle Birds (*Ptiloris*), of which two species are known, are also exceedingly beautiful birds; in fact, Mr. Gould regards the commonest species (*Ptiloris paradiseus*) as the most gorgeous in its plumage of the Australian birds. It is of a rich velvet-black, with the head and neck of a most brilliant bluish-green. The feathers of the lower surface are bordered with rich olive-green, and the two central tail feathers are metallic-green. The female is dull and sombre in its colours. This bird is found in the south-eastern portion of Australia, where it climbs upon the trunks of trees in the same manner as the Creepers (*Certhinæ*), which it resembles in its general habits. Little is known of the mode of life of the other species.

## Sub-order IV.—Fissirostres.

**General Characters.**—The last group of the Passerine birds is that of the Fissirostres, characterized by having the gape-line continued far back, usually reaching under the eyes. They are generally insectivorous birds, and many of them take their prey on the wing; the gape is accordingly usually furnished with bristles, which, by enlarging the space occupied by the mouth, greatly facilitate the capture of insects.

**Divisions.**—Mr. George Gray has divided these birds into two groups, the nocturnal and diurnal Fissirostres, according as they are organized for pursuing their food

by night or by day. This arrangement, however, scarcely appears satisfactory, and we shall therefore adopt another, which coincides pretty nearly with those of Temminck and Macgillivray, except that, in accordance with the views of most modern ornithologists, we have introduced some families of birds which those authors did not admit amongst the Fissirostres. This applies only to the first group, in which Temminck only includes the Kingfishers and Bee-eaters, to which we have added the Trogones and Rollers; the second group corresponds exactly with Temminck's *Chelidones*.

The latter group embraces the typical Fissirostral birds; they have the bill very short, broad, and depressed, and the gape exceedingly wide (Fig. 199); their wings are very long and pointed. In the other group the bill is more or less elongated, strong, pointed, and scarcely if at all depressed at the base; the gape is much narrower than in the preceding section, and the wings are shorter and less pointed. In this section we place four families.

Of these, the *Meropidæ* or Bee-eaters make the nearest approach to the Tenuirostral birds, at the same time that in their habits they present some resemblance to the Swallows. They have the bill elongated and curved; the nostrils partly concealed by short bristles; the wings long and pointed; and the tail long and broad, with the two



Fig. 274.—Head of the Common Bee-eater (*Merops apiaster*).

middle feathers usually produced considerably beyond the rest. The tarsi are very short and the toes long; the two lateral toes are more or less united to the middle one, from which character the birds were placed by Cuvier amongst his Syndactyli.

These birds are confined to the Eastern Hemisphere, in the tropical parts of which they are most abundant. They feed on insects, which they capture in the air, and are especially partial to bees and wasps, whence their English name of Bee-eaters, and the French *Guêpiers*. They are beautiful birds, generally adorned with bright colours, amongst which green usually predominates.

A single species, the *Merops apiaster* (Fig. 275), is abundant in the south of Europe, and occasionally individuals stray so far to the north as to reach this country, and specimens have even been killed in Sweden. It is a bird of passage in Europe, its actual home being on the continent of Africa, in all parts of which it is found, even as far south as the Cape of Good Hope.

The common Bee-eater is a very beautiful bird It is nearly eleven inches in

length from the tip of the bill to that of the tail, which is increased in length by the production of the two middle feathers, although this character is far less distinct in this bird than in many of the exotic species. The colour of the upper part is brownish-red, becoming yellow on the rump; the forehead is pale blue; a black streak runs along each side of the head to a considerable distance behind the eye, where it joins a black band which crosses the throat, and the space included between these black marks is of a rich yellow colour. The lower parts, and the wings and tail are of different shades of green.

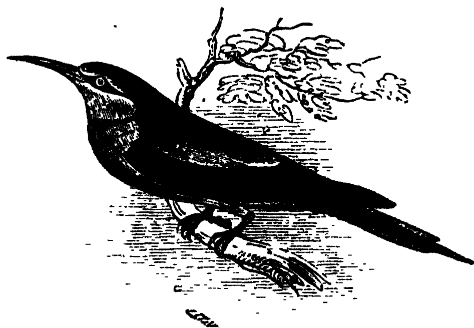


Fig. 275.—European Bee-eater (*Merops apiaster*).

These elegant birds cross the Mediterranean in the spring from the north coast of Africa into the south of Europe, where they breed. They come in flocks of twenty or thirty together, and appear to be gregarious in their habits, as they are constantly seen hawking about in company in the same manner as Swallows. Their sociability lasts even during the breeding season, their nests, which are excavated in banks, being frequently seen in great numbers together. Montagu says that in the south of Russia, where they are exceedingly numerous, the clayey banks of the Don and Wolga are excavated to such an extent as to have the appearance of honeycomb. Their holes are about six inches deep, and lined with soft moss, on which the bird lays from five to seven white eggs. They have a warbling note, which is uttered whilst on the wing in pursuit of their prey.

The Bee-eaters are said to be exceedingly abundant in the island of Crete, where they are often taken by the boys in a very singular manner. A *Cicada* is fastened to a bent pin or fish-hook, which is attached to a long slender line. The insect is then allowed to fly, and as soon as a Bee-eater catches sight of it he dashes at it, and swallowing the baited hook is readily captured.

The habits of the other species of this group agree very closely with those of the European species; but some of the Indian species, such as the common *Merops viridis*, frequently select a perch in some prominent position, whence they dash off in pursuit of any insect that comes within sight, returning again to their perch in the same manner as the Flycatchers. On returning to their station, Mr. Layard has observed them beating their prey against the perch to bruise it before swallowing it. This mode of capturing food is principally resorted to in the middle of the day, for in the mornings and evenings these same species may be observed hawking about in company with the Swallows.

The *Alcedinidæ*, or Kingfishers, have the bill elongated, usually straight, broad at the base, and acute at the apex; the wings are long and rounded; and the tail usually short. The tarsi are always short and strong; but the toes are elongated and very variable in their arrangement, being sometimes placed in the ordinary position, three in front and one behind; and sometimes, as in the Parrots, two and two; whilst in some species there are only three toes, two in front and one behind.

Of the three sub-families into which we divide this group, that of *Galbulinæ*, or Jacamars, approaches most nearly to the Bee-eaters. In these birds the bill is long, slender, straight, and pointed, or very slightly curved; the wings are of moderate length, with the fourth quill longest; the tail is elongated and graduated, the central feathers being very long, and the lateral ones rapidly decreasing in length; the tarsi are short, and the toes are either arranged in two pairs, or two in front and one behind, the anterior toes being united.

The Jacamars are handsome birds, adorned with bright colours; green being usually predominant, as in the Bee-eaters. They are peculiar to the tropical parts of South America and the islands of the West Indies, where they generally lead a solitary life in the recesses of the forests, perching upon the branches of trees to look out for insects, which they capture in the same way as the Bee-eaters. They breed in the holes of trees.

In the sub-family of the *Alcedininæ* or true King-fishers, the bill is long, straight, angular and pointed, always stouter than in the Jacamars. The body is also stouter in its form, and the tail is short. The wings are short and rounded, with the third, or third and fourth, quills the longest; the tarsi are very short, and the toes long, the anterior ones sometimes two, sometimes three, in number, but always more or less united. Mr. G. R. Gray divides these birds into two groups,—the *Alcedininæ* and the *Dacelonina*; they are distinguished principally by slight differences in the bill, which is considerably stouter in the second group; but as the birds agree in other respects, we have not thought it necessary to follow this arrangement.

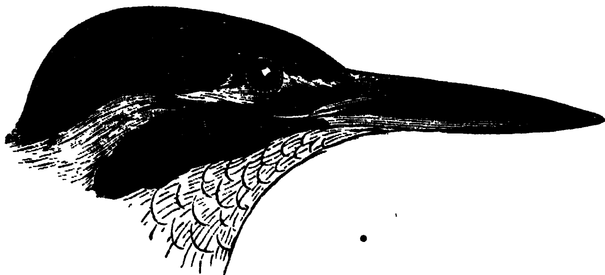


Fig. 276.—Head of the Kingfisher (*Alcedo ispida*).

The habits of these birds are very remarkable. Most of them feed almost entirely upon small fishes, which they capture by dashing into the water from some perch on which they sit to watch for their prey, and so exact is their aim that they almost invariably succeed in their object.

The food of the *Alcedininæ* of Mr. G. R. Gray, in fact, consists exclusively of fish; but the *Dacelonina* of the same author also feed upon small Reptiles, Crustacea, and Insects. The species of both groups build their nest in holes, but those of the former choose cavities in the banks of rivers for this purpose, like the Bee-eaters, whilst those of the latter select holes in the trunks of trees. The great majority of the species are found in the tropical parts of the world, the strictly fish-eating forms being common to both hemispheres; whilst those of which the diet is more mixed, are confined to India, the Islands of the Eastern Archipelago, and Australia.

In this country we have a single representative of the group, the common King-fisher (*Alcedo ispida*, Fig. 277), which belongs to the first section. It is a most beau-

tiful species, adorned with colours which would seem rather to belong to a tropical bird than to one inhabiting the cold climate of our native land. It measures about seven inches in length; the upper part of the head, the wing-coverts, and a stripe on each side of the neck, are green, covered with light blue spots; the upper part of the back is dark-green, the lower part and rump bright blue; the throat, and a streak on each side of the neck are yellowish-white, and the lower parts pale-chestnut. The quill-feathers of the wings are greenish-black, and those of the tail deep-blue.

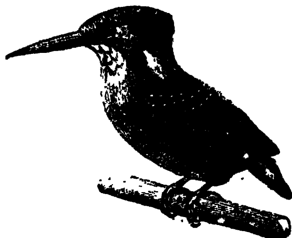


Fig. 277.—Kingfisher (*Alcedo ispida*).

The Kingfisher resides in this country all the year, and although not by any means an abundant bird, is very generally distributed all over the kingdom, except in the extreme north of Scotland. It is a solitary bird, inhabiting the banks of small streams, and perching upon the branches of trees overhanging the water to watch for its finny prey. For the purpose of breeding, the Kingfishers are said to take possession of a hole in the bank formed by some burrowing animal, and here they appear to resort to disgorge the bones of the fishes which they have swallowed, for the floor of the holes frequented by them is always found covered with these remains, and it is upon these that the female lays her eggs. These are usually from five to seven in number, and of a delicate pinkish white colour.

There appears to be some doubt as to whether the Kingfisher really adopts the deserted hole of some other animal, as its breeding place is sometimes found in situations not usually selected by the burrowing Mammalia. It seems certain, however, that when they do select a ready-formed dwelling, they take some pains to adapt it to their own convenience, as the Kingfisher's nest usually presents a characteristic form. This is rendered especially probable by the fact that the common American species (*Alcedo alcyon*), which resembles our native bird in its general habits, is known to dig to a depth of four or five feet into the clayey or sandy banks of the streams which it frequents.

Amongst the ancients the most extraordinary ideas were entertained with regard to the nidification of the Kingfisher; and as these also pervade the writings of our own older poets, some account of them may not be unacceptable. It was believed that the bird made a floating nest on the sea, and that during the period that she was engaged in hatching her eggs, the water always remained so smooth and calm that the mariner might venture on his voyage without danger of being exposed to any of the dangers of the stormy seas; in fact, some of the ancient writers attribute to this little bird the power of allaying the violence of the waves. The period of incubation was accordingly known as the "Halcyon days" (Halcyon being the Greek name of the bird), and the same term is still often employed metaphorically to express any period of uninterrupted happiness. Some of the modern superstitions connected with the Kingfisher are scarce less curious; it has been supposed that when the body is suspended by the bill its breast will always indicate the north, that when suspended and accurately balanced, its bill will always point in the direction of the wind, although the bird may be kept in doors, and that the possession of its head and feathers furnished a protection against witchcraft, a security for fair weather at sea, and a certain means of securing the affections of a coy or disdainful sweetheart. We believe these superstitions still hold their ground in some parts of the country.

The flight of the Kingfisher, notwithstanding the shortness of its wings, is exceedingly direct and rapid, and it not only takes its prey by plunging into the water from a perch, but also by hovering over it until its prey passes beneath, and then dashing down in the manner of a hawk. Its note is said to be shrill and piercing, and to be frequently emitted on the wing.

The largest species of the group belong to the section including the genus *Dacelo* and its allies, one of which, the *Dacelo gigas*, a native of Australia, measures eighteen inches in length. These birds do not confine themselves exclusively to the banks of rivers, but may also be met with in woods and fields, where they feed indiscriminately upon almost any animal of suitable size. They are fine birds, and the great power of the bill renders them rather formidable; indeed there is an instance on record of an Indian species, the *Halcyon leucocephalus*, having got the better in a contest with a good-sized Hawk which had seized upon him, the Kingfisher giving his enemy a blow on the breast with his bill, which compelled him to quit his hold. The note of these birds is a sort of screaming laugh, which has obtained the name of the laughing Jackass for one of the Australian species.

In the sub-family of the *Bucconinæ*, or Puff-birds, the bill is very stout and conical, and inflated at the base, which is furnished with several tufts of strong bristles; the tip of the upper mandible is curved or hooked; the nostrils are concealed by the plumes and bristles of the forehead; the tarsi are about the length of the outer anterior toe, which is the longest; and the toes are arranged in pairs, in the same way as in the Scansorial birds, with which the Bucconinæ were formerly placed. The name of Puff-birds is given to them from the manner in which their plumage is puffed out; a character which gives them a dull, heavy appearance. This aspect is in accordance with their mode of life, as they are solitary and melancholy birds, inhabiting the recesses of the forests of tropical America, where they perch upon the branches of trees to look out for the insects which constitute their food. They are said to perch in the same spot for months together. They also occasionally creep upon the bark of trees in search of insects, supporting themselves with the tail when in this position, like the Woodpecker. They nestle in holes of trees.

The beautiful family of the *Trogonidæ*, or Couroucous, have the same tufts of bristles at the base of the bill as the Bucconinæ, but the form of the bill is very different. It is short, strong, broader than high, and presents a triangular outline when seen from above; the ridge of the upper mandible is arched, and the margins and tip are usually toothed. The wings are of moderate size and rounded; the tarsi more or less clothed with plumes; and the toes are of unequal length, and arranged in two pairs. Their plumage is usually adorned with bright colours, and often most brilliantly metallic; and the beauty of their appearance is frequently greatly enhanced by the elegance of their long tails.

They are found in the tropical regions of both hemispheres, but most of the species inhabit South America. They frequent the thickest parts of the forests, where they feed principally upon insects which they capture on the wing, and sometimes pick from the bark of trees. Some of the species, however, derive their chief nourishment from fruits and berries. They lay their eggs in the holes of rotten trees, upon the débris usually found in such situations, and, like the Woodpeckers, frequently enlarge the holes by means of their strong bills. Their cry is peculiar and melancholy, resembling the word *couroucou*, which has hence been applied to them as a vernacular name.

The Trogons vary considerably in size, some of the smallest being little larger than a Sparrow, whilst the largest appear to be about the size of a Magpie. One of the largest and finest species is the *Trogon resplendens*, the plumage of which is of a beautiful bronzed golden green colour, and the two middle feathers of the tail, which are much longer than the body and very broad, give it a peculiarly graceful appearance. It is a Mexican bird, and its gorgeous plumes are much sought after by the natives of that country as ornaments, but at one time they were only allowed to be worn by persons of the highest rank.

These birds are exceedingly difficult to procure, from their usually frequenting the highest trees of the forest, and when the collector has succeeded in shooting them they generally lose a portion of their light plumage in their fall, whilst the extraordinary tenderness of their skins render the operation of skinning them a most difficult matter. The specimens of the magnificent species above referred to, are usually obtained from the Mexican Indians, who appear to be so well aware of the almost impossibility of skinning them that they never make the attempt, but merely dry the body within the plumage.

The family of the *Coracidæ*, or Rollers, the last in this section of the Fissirostres, presents a considerable resemblance to some of the Conirostral and Dentirostral

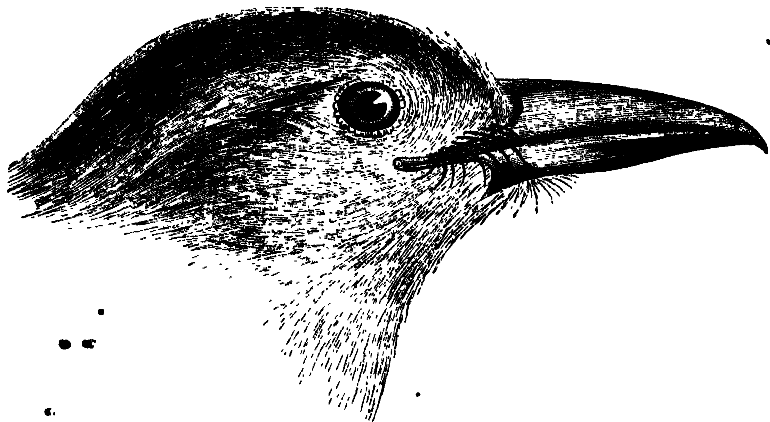


Fig. 278.—Head of the Roller (*Coracias garrula*).

birds, amongst which it was in fact formerly placed. The bill in these birds is elongated, broad at the base and compresssd towards the tip, which is considerably hooked and sometimes slightly notched. The tarsi are short and the toes moderately long, the outer toe being sometimes free and sometimes united to the middle one at the base.

The birds referred to this group by Mr. G. R. Gray form four sub-families. The first of these, the sub-family of the *Momotinæ*, or Motmots, is distinguished at once by the peculiar character of the bill, the lateral margins of which are serrated. The wings are short and rounded; the tail long; the outer toe is longer than the inner one, and united to the middle one as far as the second joint, and the hind toe is short and weak. The tongue is pectinated, like that of the Toucans (page 245), and from this circum-

stance some of the species were described as belonging to the genus *Rhamphastos*. The name of *Motmots* applied to these birds, is said to be their denomination in the Mexican language, derived from their peculiar note.

The Motmots are confined to the tropical regions of America and the West Indian Islands. They are found only in the deepest recesses of the forests and about the ruins of ancient buildings, on which, and the branches of trees, they perch in solitude, with the head drawn back between the shoulders, and every now and then emit a sort of hoarse croak. In the morning and evening, however, they show a greater degree of activity in pursuit of the insects which constitute their principal sustenance; these they take by pouncing upon them after a short flight. They do not confine themselves to such small game, and as their average size is about that of a Blackbird, they are able to prey upon lizards and small snakes, and even occasionally upon small birds. They are said to take these larger objects up in the bill, throw them up into the air, and swallow them as they fall. Fruits also form a portion of their food.

They are said generally to make their nests in the holes of trees, but Sir William Jardine mentions that the nest of a species of this group was found in a bank of marl, and was of a rather complicated construction. It commenced by an entrance passage about two inches and a half in width, which ran in a straight line horizontally to a depth of about five feet. It then turned at right angles and proceeded downwards for about five feet more, and at this point terminated in an enlarged chamber, within which three young were found, on the top of a mass of maggots and the remains of insects.

The Motmots are remarkable for a curious sort of mutilation which they are supposed to practice on themselves. The two middle feathers of the tail are considerably elongated, and in most specimens the barbs are wanting on a portion of the stem a little before the tip, so that a portion of the shaft is left quite bare at this point. There seems to be no other way of accounting for this than by supposing that the birds, probably from some mistaken notion of elegance, must have deliberately picked off the barbs of the part of the feathers.

The best known species is the *Momotus Brasiliensis*, which is about the size of a Blackbird, and of a deep rich green colour, with the forehead bluish, the back of the head violet, and the crown black.

The *Todinæ*, or Todies, are also readily distinguished from the other members of the group by the form of the bill, which is elongated, and exceedingly broad and flat, so that it has been described by some authors as consisting of two thin plates; the upper mandible is usually obtuse at the extremity, and the nostrils are placed at some little distance from its base on the surface of the bill. The tarsi are of moderate length, and slender, and the outer toe is longer than the inner, but both are united to the middle one to a greater or less extent. They are robust little birds, which have been compared in form to the Kingfishers; but they have the tarsi and tail considerably longer than these birds, and the bill is very different.

The number of species of Todies is very small; Mr. G. R. Gray only records four in his "Genera of Birds." They are inhabitants of the tropical parts of America and the West Indian islands, and feed principally on insects; these they capture whilst hopping about upon the branches of the trees, and also by a sudden flight, in the same way as the Flycatchers. They also seek for worms, and even small reptiles, upon the ground. It is on the ground also that they make their nests, in a small hole which they excavate for this purpose, and line with dried grass and straw.

One of the best known species is the Green Tody (*Todus viridis*), which is an

exceedingly common bird in some of the West Indian islands. It is about the size of a Wren; all the upper parts are of a vivid grass green colour, the neck and throat are red, the breast whitish, and the belly yellowish. It is a bold and familiar bird, paying little attention to the presence of man, and exhibiting great confidence when in captivity, seeking its insect prey in the room with the greatest freedom. Its holes for nestling are dug in banks to the depth sometimes of eight inches or a foot.

Nearly allied to the Todies are the *Eurylaiminæ*, which appear to represent the preceding group in India and the Eastern Archipelago. Their principal difference consists in the structure of the feet, the outer toe only being united to the middle one. The nostrils also are placed near the base of the bill. They are generally of small size, but adorned with beautiful colours, and live in the most retired parts of the countries inhabited by them, principally in marshy places and along the margins of lakes and rivers. They are usually seen in small flocks, and feed for the most part upon insects and worms, although the stomachs of some of the species have been found to contain nothing but vegetable substances. Their nests, which are composed of small twigs, are suspended from the extremities of the branches of trees, usually those overhanging the water; and the number of eggs is said to be only two.

In the *Coracinæ* or Rollers, forming the last sub-family of this group, the bill is elongated and compressed, higher and more broad at the base, and distinctly hooked at the tip, the extremity of the upper mandible overhanging that of the lower one (Fig. 278); the nostrils are basal, and the toes are all free at the base.

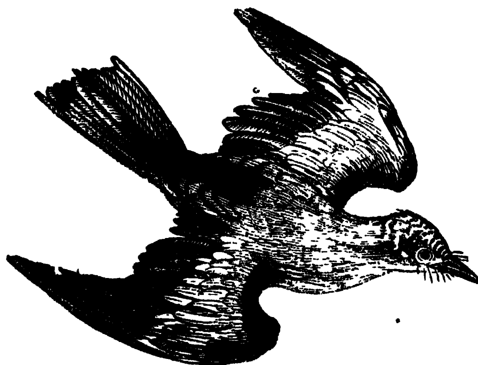


Fig. 279.—Roller (*Coracias garrula*).

These birds, which are of moderate size and usually adorned with bright colours, are found only in the Eastern Hemisphere, and especially in the warmer regions. Their food consists of fruits and insects. A single species, the common Roller (*Coracias garrula*, Fig. 279), occurs in Europe, and occasionally visits this country. It is about the size of the common Jay; the back is light brown; the head, neck, and lower surface, bluish-green; the lesser wing-coverts are bright blue; and the quills light greenish-blue at the base, with the apical portion bluish-black. The tail feathers are also greenish-blue, and some of the outer ones tipped with black.

This fine bird is a native of Africa, but a great many of them make a regular summer migration into Europe, where they breed; some even reaching as far north as Sweden. It is, however, of rare occurrence in these northern regions, and even in this country is to be regarded only as an occasional visitor. It is a squalling, noisy bird, and exceedingly shy and restless; and these qualities, coupled with its preference for the most secluded parts of forests, render it a difficult bird to procure. In Germany it is said to be not unfrequent in some of the great forests, where it lays its eggs in the

holes of trees, generally preferring birch trees for this purpose; in allusion to this one of its German names is *Birkhäher*, or the Birch Jay. In other countries, however, it is stated to breed, like the Bee-eaters and Kingfishers, in holes excavated in the banks of rivers; and this, from the testimony of several observers, appears to be the most common locality. The eggs are usually four in number, and of a shining white colour. The Roller feeds principally upon insects, which it takes in any situation; it also devours worms, slugs, and even small reptiles and fruits.

In the European Roller the tail is almost even at the end, although in the male the outer tail feathers are often a little elongated; but in some exotic species these feathers attain a considerable length, and in the *Coracias Abyssinica*, they terminate in long, slender filaments. In the genus *Eurystomus*, the bill, contrary to the general character of the group, is very broad and depressed, and the birds take the greater part of their insect food on the wing.

With these birds we conclude the first section of the the Fissirostral birds. The second, including the typical Fissirostres, is divided into three families, the *Hirundinidæ*, the *Cypselidæ*, and the *Caprimulgidæ*, the members of the third being readily distinguishable from those of the two former by their manifest adaptation to nocturnal or crepuscular activity.

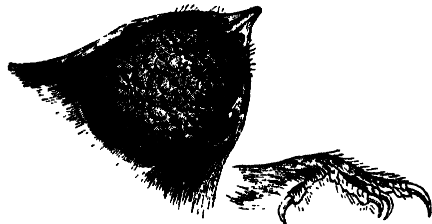


Fig. 280.—Head and Foot of the House Martin (*Hirundo urbica*).

The *Hirundinidæ*, or Swallows, have a short, depressed, and somewhat triangular bill, with a very wide gape, furnished with short bristles. The nostrils are rounded and of moderate size: the wings (Fig. 281) long and pointed, with the first quill longest: the tail is more or less forked, and the feet are of the ordinary form of those of the Passerine birds, with three toes before and one behind. Their sternum also, as in the majority of the Passeres, exhibits a notch on each side behind, and their trachea is furnished with muscles at the inferior larynx so that they are enabled to produce a modulated song.

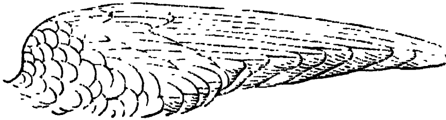


Fig. 281.—Wing of Martin (*Hirundo urbica*).

The Hirundinidæ are slender and elegant little birds, possessing great power of flight, which is not only shown in the swiftness with which they dart along, but also in the readiness with which they turn in the air in every direction, a faculty which renders their evolutions, when engaged in the capture of their insect prey, exceedingly graceful. Their nourishment consists exclusively of insects, which they take on the wing; and they are usually seen in the neighbourhood of water, the numerous insects hovering over which afford them an inexhaustible supply. They drink on the wing by sweeping close along the surface of the water, and some of the species also wash themselves by a sudden plunge into the water. They are for the most part inhabitants of the tropics, and those species which breed in temperate climates always migrate to more genial regions at the approach of winter. They breed sometimes in holes, and

sometimes build a nest against the side of a rock or building, or upon the trunks of trees. In these cases their dwelling is usually formed of mud.

Three species are regular summer visitors to this country, and the winter residence of all of them is on the continent of Africa; but they also occur in Asia, and have been killed in India. They all arrive in this country from the beginning to about the middle of April, and appear to take their departure towards the end of October. They cross the channel either singly or in small parties of rarely more than two or three together, and it is remarkable, considering their great power of wing, that they arrive apparently quite as completely exhausted as other migratory birds whose endowments in this respect are far inferior. Thus the channel fishermen say that the Swallows often alight upon their boats when at a short distance from land, especially in hazy weather; and that they appear so much fatigued, that they can scarcely fly from one end of the boat to the other when an attempt is made to capture them. In fine weather they are sometimes seen to drop upon the water with their wings expanded, and soon afterwards to fly off again apparently refreshed by their bath. They appear to return every year to the same locality, and even to the same nest. It was at one time generally supposed that the Swallows passed the winter in this climate in a state of torpidity, some persons believing that they retired into holes and caverns at this season, whilst others maintained that they clustered together upon the ends of the twigs of trees overhanging the water, which were thus dragged beneath the surface by their weight, so that they passed the winter submerged. Of these notions the second is evidently absurd, and the first is now regarded as untenable.

Of our British species, two are remarkable for their attachment to the vicinity of human habitations, upon some part of which, in fact, they generally build their nests. One of them, the *Hirundo rustica*, is commonly called the Chimney Swallow, from its so frequently building its nest in the interior of chimneys, generally a few feet from the top; it by no means confines itself to this situation however, but will build in almost any place to which it can have access, as in old wells and the shafts of mines, or amongst the rafters of barns and sheds. The bird generally selects some place where a salient angle furnishes a good support for its little edifice, which is constructed of small pellets of soft earth or clay plastered together, and bound by the addition of fragments of straw and grass. It forms an open cup, the bottom of which is lined with feathers, and upon these the female lays from four to six white eggs, spotted with ash colour and red. When the young are hatched the parents are most assiduous in their attention to their wants, visiting the nest with food about once in every three minutes throughout the day. When the young are ready to leave the nest, the old birds still attend to them for a time, and, as described by Gilbert White, "the progressive method by which the young are introduced into life is very amusing. First, they emerge from the shaft with difficulty enough, and often fall down into the rooms below; for a day or so they are fed on the chimney-top, and then are conducted to the dead leafless bough of some tree, where, sitting in a row, they are attended with great assiduity, and may then be called *perchers*. In a day or two more they become *flyers*, but are still unable to take their own food; therefore they play about near the place where the dams are hawking for flies; and when a mouthful is collected, at a certain signal given, the dam and the nestling advance, rising towards each other, and meeting at an angle; the young all the while uttering a little quick note of gratitude and complacency."

The Swallow produces two broods in the season, and it not unfrequently happens

that the second brood is not ready to leave the nest when the period of emigration arrives; and so strong is the instinct which prompts the birds to undertake this journey that they have been observed to leave their unfledged young to perish. The male Swallow is a sweet songster, and sings both perching and flying. In confinement he is very tame, and in his natural state is an exceedingly courageous bird, attacking birds of prey with great courage, and occasionally striking at cats when they climb to the roof of the house and appear to be getting too near his nest. At the approach of one of these enemies, the Swallow sounds the alarm, and immediately all the Swallows and Martins within hearing flock to the attack, when, if it be a hawk, they pursue him until they have driven him out of the neighbourhood, pouncing down upon him from above, and rising again perpendicularly in perfect security. The Swallow is readily distinguished by its very elongated forked tail, which measures more than half its total length, and by the brownish-red colour of the forehead and throat.

The Martin (*Hirundo urbica*, Fig. 280), is a rather smaller bird than the Swallow, has the tail much shorter and less forked, and is destitute of the brownish-red marks upon the head and throat. It is even more familiar than the Swallow, not only breeding like it in the neighbourhood of human habitations, but even in the heart of large towns, a situation in which its congener is rarely if ever seen. In its habits it closely resembles the preceding species; but its nest, instead of being built in the interior of buildings, is always placed upon the outside, usually under the projecting eaves, or in windows and doors. The nest is formed of soft earth or clay, and is of a hemispherical form. It is lined with a little hay and a few feathers, upon which the female lays four or five white eggs.

The Sand Martin or Bank Martin (*Hirundo riparia*), is the smallest of our British Swallows, and is less known than either of the preceding species, as its habits do not lead it so immediately into the neighbourhood of houses. The nest is formed in the high banks of rivers, in sand-pits, and similar situations, in which the little bird digs most perseveringly until it has excavated a gallery of two feet, or even more, in depth, at the termination of which the eggs are laid upon a small bed of hay and feathers. The galleries are beautifully circular, and usually wind a little towards the extremity; and the dexterity of the little miner is such as to excite the highest admiration at his workmanship. The eggs, like those of the House Martin, are white. Like that bird, also, it is very mute. It occurs also in North America.

Of the North American species, one of the best known is the Purple Martin (*Progne purpurea*), which is a regular summer visitor to the United States, by the inhabitants of which it is universally regarded as a favourite,—so much so that in every part of that country it is the practice to put up conveniences for it to nestle in, sometimes a box or hollow gourd on the top of a pole or sign-board, and sometimes a more complicated arrangement of apartments resembling a pigeon-house. In the absence of any such preparation for their reception the birds will build in any hollow about the houses, and occasionally find their way into pigeon-houses, where they will take possession of a whole tier of nests, and never suffer the least intrusion from the rightful inhabitants of the place. The flight of this bird is very swift and elegant, and he is one of the most determined enemies of the birds of prey to be found in the United States. Wilson says, the Purple Martin, "like his half-cousin the King-bird (*Tyrannus intrepidus*), is the terror of Crows, Hawks, and Eagles. These he attacks whenever they make their appearance, and with such vigour and rapidity that they instantly have

recourse to flight. So well known is this to the lesser birds and to the domestic poultry, that as soon as they hear the Martin's voice engaged in fight all is alarm and consternation. To observe with what spirit and audacity this bird dives and sweeps upon and around the Hawk or the Eagle is astonishing. He also bestows an occasional bastinadoing upon the King-bird when he finds him too near his premises, though he will at any time instantly co-operate with him in attacking the common enemy." It is to this habit that the bird is greatly indebted for the favour shown to him in all quarters, as the establishment of a colony of Martins in the vicinity of the farmer's homestead would be quite sufficient to protect the denizens of the farm-yard from the depredations of predaceous birds. The Purple Martin is about eight inches in length, and entirely of a fine purplish-blue colour, with violet metallic tints, except the quill feathers of the wings and tail, which are brownish-black; the female is blackish and grayish-brown, tinged with blue. Specimens of the bird have been shot in this country.

Several other species of Hirundinidæ visit the United States every summer, their winter quarters being probably the tropical parts of South America. One of these, the *Hirundo rufa*, which is very nearly allied to our *H. rustica*, and was indeed formerly regarded as the same species, is there called the Barn Swallow, from its constantly building its nest on the beams and rafters in barns, sheds, and similar places. It is regarded with almost as much favour as the Purple Martin, although, from its nest being composed of mud, it does not require any such inducements to build in the neighbourhood of man that we have seen to prevail with that bird, and Wilson says that scarcely a barn to which they can obtain access is without them. The same author adds that the proprietor of a barn in which there were upwards of twenty nests assured him, "that if a man permitted the Swallows to be shot his cows would give bloody milk, and also that no barn where Swallows frequented would ever be struck by lightning."

Another species, the *H. viridis*, which has been considered identical with our House Martin, is also abundant in the United States, where it forms its nest in similar situations to those selected by the Purple Martin. "For some time before their departure," according to Wilson, "they subsist principally on the myrtle berries (*Myrica cerifera*), and become extremely fat."

Several species are found in the East Indies, some of which are permanent residents



Fig. 282.—Head of the Common Swift (*Cypselus apus*).

there, whilst others disappear during the hot season, probably migrating to the temperate parts of Asia. Their habits are the same as those of the British species. Some

of them breed in the holes of walls and similar situations, others, like our Sand Martin, burrow into the banks.

The Swifts, formerly included amongst the Swallows, and placed as a sub-family of the Hirundinidæ by Mr. G. R. Gray, appear to possess distinctive characters of sufficient importance to entitle them to rank as a separate family—that of the *Cypselidæ*. They resemble the Swallows in their general form, and the structure of the bill (Fig. 282), is very similar; but the feet are different from those of any other bird, all the four toes being directed forwards (Fig. 283). The nostrils are very large, oblong, and furnished with an elevated margin, and the wings are extremely long and narrow (Fig. 284). The Swifts also differ from the Swallows in the structure of the trachea, the inferior larynx being destitute of those muscles which confer their powers of melody upon the true singing birds, and this has induced some naturalists, who have adopted the characters derived from the presence or absence of these peculiar organs as a means of dividing the Passerine birds into two sections, to place the Swifts and Swallows at a considerable distance apart. According to the views of these authors, the nearest allies of the Swifts are the Humming-birds, with which they also agree in the structure of the sternum, which is destitute of posterior notches in both groups.

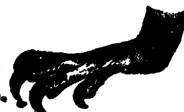


Fig. 283.—Foot of the Common Swift.

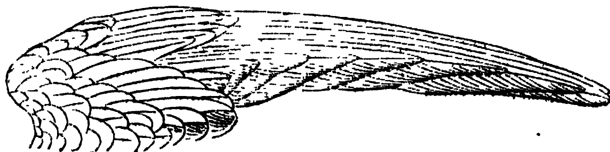


Fig. 284.—Wing of the Common Swift.

In their habits the Swifts closely resemble the Swallows, but perhaps even excel those active and graceful birds in activity and swiftness of flight. Like the Swallows, they feed exclusively on insects, which they capture on the wing, and, like them, they are also, for the most part, migratory birds, passing the winter in warm climates, and advancing into the more temperate regions as the heat increases. The European species remain in their summer haunts for a shorter period than any other migratory birds, leaving for the south long before the Swallows. They nestle, for the most part, in the holes of buildings, or in the crevices of rocks.

The Swifts are generally distributed in all parts of the globe, but only two species occur in Europe, and of these only one is found commonly in this country. This is the common Swift (*Cypselus apus*, Fig. 282), a small bird about seven inches and a half in length, with a forked tail; the plumage is blackish-brown with a green gloss, and the throat is grayish-white. It is found abundantly in all parts of the country, and may be seen, sometimes in great numbers, hawking about in the air in search of insects, especially in the morning and evening. Whilst thus engaged their evolutions are most interesting; they dart along with extreme rapidity, turning and winding in the air with a facility which is perfectly astonishing, and continually uttering a shrill scream, which is their only note. The insects on which they feed are very small, and they generally collect a considerable quantity in their mouths before swallowing them; the prey being prevented from escaping by a viscid secretion produced by peculiar

glands, which lines the interior of the mouth. From the extreme shortness of the legs the Swifts are almost incapacitated from walking, but their feet form admirable clinging organs, which are of great advantage to them in getting into the holes and crannies in which their nests are placed. From the same cause also they are unable to rise from a flat surface, and this prevents their collecting the straws and feathers of which their nests are composed by alighting on the ground, as is done by most other birds. These materials are therefore picked up with the greatest dexterity as the bird sweeps swiftly along close to the surface of the ground, and then conveyed at once to the hole selected for a breeding-place, in a steeple or tower, or in the face of a rock, and usually at a great height. The nest is bulky and rather clumsy; the eggs two or three in number, and of a pure white colour; and the birds, unlike the Swallows, produce only a single brood in the season. Like the Swallows they are said to return annually to the same breeding place, and even to make use of the same nests which had served them previously.

Of the second species, the White-bellied Swift (*Cypselus melba*, Fig. 199), only a few specimens have been killed in this country, but in the southern parts of the continent it occurs abundantly every year. It may readily be distinguished from the common species by its larger size and the whiteness of the lower surface; the plumage of the upper parts are of a grayish-brown colour. Its habits are the same as those of the common species, and, indeed, all the birds of this family agree so closely in this respect, that with very few exceptions one description will apply generally to the whole.

Amongst these exceptions we may notice that many, perhaps most, of the exotic species, such as the Indian *Cypselus affinis*, the *Tachornis phœnicobia*, or Palm Swift of Jamaica, and even the North American Chimney Swift (*Acanthylis pelasgia*) rear two or three broods in a season; and that the nests of some of the species, such as the Jamaica Palm Swift just referred to, and the Indian Palm Swift (*Cypselus Batassiensis*), and the species of the genus *Dendrochelidon*, attach their nests to the trunks of trees. Some of the species, also, like our common Martin, construct their nests of mud, but these habitations are usually composed of the same materials as those of the common Swift, more or less agglutinated together by the viscid secretion produced by the peculiar glands of the mouth. The nests of the common Swift generally exhibit this character to a certain extent, but many of the species, especially those which attach their nests to the surface of the supporting body, make a much greater use of the glutinous secretion, and in some species of the genus *Collocalia*, this constitutes the great bulk of the nest.

To this genus belongs the Esculent Swallow as it is called (*Collocalia esculenta*), the principal fabricator of the celebrated bird's nests which enjoy such a high repute amongst the Chinese for their excellence as an article of food. These nests are composed of a mucilaginous substance, usually more or less mixed with fragments of grass, hair, and similar materials; they are attached to the surface of rocks in caverns, and the birds always build in great numbers together in the same cave. It was formerly supposed that the mucilaginous matter employed in the construction of the nests, was obtained from seaweeds eaten by the birds, and from this belief Thunberg gave the name of *Hirundo fuciphaga* to one of the species, but it is now ascertained beyond doubt, that the substance in question is secreted by greatly developed salivary glands. The birds which build these nests, of which there are two or probably more species, are found in great abundance in all parts of the Eastern Archipelago, and also on the continent of India; they are collected in great quantities and constitute an important article of commerce with China.

Almost all our knowledge of the mode in which the harvest of nests is managed, is derived from the Island of Java, which produces about 200 peculs, or 256 cwts. annually. The nests are collected in Java at three different periods, namely in March, October and December. The interval of six months, from March to October, gives the birds time to rear two broods, and the quantity of nests is consequently greater than at the other two periods of collecting, but the produce is generally of inferior quality; the intervals of three months, between the collection in October and that in December, and again between the latter and that in March, scarcely allows the birds to get their progeny out of the nests, and many young birds are accordingly destroyed at these periods, but the nests are of superior quality and very white. The prices paid for these nests in the Canton market vary greatly according to the quality; those of the best and purest sort fetch the enormous price of 3,500 Spanish dollars the pecul, or about £5 10s. per pound; the second quality produces 2,800 Spanish dollars per pecul, and the third not more than 1,600 dollars. In some parts of China, however, as much as £9 has been paid for a catty of bird's nests, or rather more than 1¼lbs. These expensive articles of food are principally employed in making soup, but they are also made use of in various ways, and are regarded as a great delicacy by the Chinese epicures. They are also highly valued from a belief that they have an aphrodisiac effect upon the consumer.

The last family of the Fissirostral birds is that of the *Caprimulgidæ* or Goatsuckers. These birds form the tribe of *Fissirostres nocturnæ* of many authors and may readily be distinguished from the Swallows and Swifts, with which they are nearly allied, by the large size of the eyes and the softness of their plumage, characters which they possess in common with the generality of night-flying birds. The bill is short, depressed, and very broad, with an enormously wide gape, which extends completely beneath the eyes and is bordered by long stiff bristles; the tarsi are short and the toes rather long and strong; the hind toe is united at the base to the inner one. The wings in this family

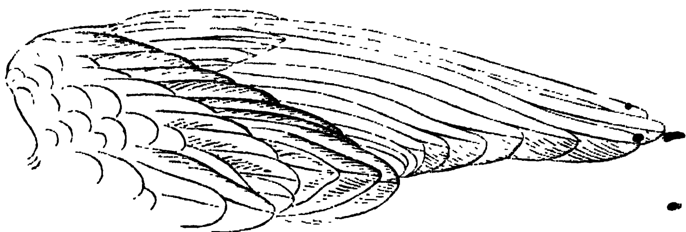


Fig. 285.—Wing of the Goatsucker. (*Caprimulgus europæus*).

are long and pointed but considerably shorter and broader than in either of the preceding groups (Fig. 285).

In the typical sub-family of the *Caprimulginæ* or True Goatsuckers, the bill is very short and weak; the tarsi are short, and frequently covered with plumes, and the lateral toes are equal in length and shorter than the middle one, which is furnished with a pectinated claw (Fig. 286). These birds are found in all parts of the world, and the habits of all the species are exceedingly similar. They all fly about in the dusk, and sometimes well on into the night, seeking the insects, principally moths and beetles which select the same period of the day for their rambles, and in pursuit of these their volutions are as active and elegant as those of the Swallows. Their soft plumage,

enables them to fly noiselessly through the air, and their large eyes, by collecting a great quantity of light, confer upon them the power of perceiving their insect prey, when the shades of evening have entirely concealed it from ordinary visual organs.



Fig. 286.—Foot of the Goatsucker. (*Caprimulgus europæus*).

The enormous width of the gape, (Fig. 287), enlarged as it is by the long stiff bristles which spring from each side of the upper mandible, is of great service to them in capturing their prey, but the statement of some authors, that the Goatsuckers fly with their mouths wide open appears to be entirely destitute of foundation. Their feet are very short and weak, and not fitted for perching in the ordinary manner, so that the birds usually rest upon the branches of trees in the direction of their length, crouching down upon them as if fearful of falling off. They also frequently settle on the ground, and are fond of basking in the sun in this position; when thus engaged they are said to lie so close that they may almost be trodden under foot before they will rise. The weakness of their legs also renders them almost incapable of walking, and their utmost efforts in this way can only produce a sort of hobble. The Goatsuckers nestle on the ground, usually under the shelter of a bush, but they make scarcely any nest. Their eggs are usually two in number.

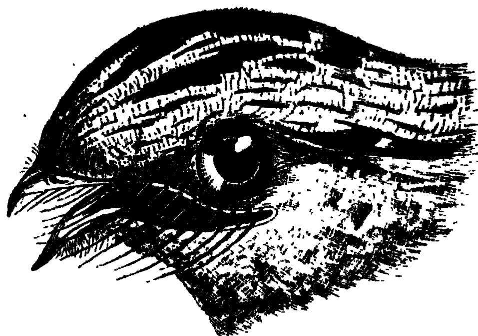


Fig. 287.—Head of the Goatsucker. (*Caprimulgus europæus*).

The use of the singularly pectinated claw on the middle toe of these birds has not yet been satisfactorily made out, although several naturalists have put forward different theories upon this subject. The most commonly received opinion is that the bird uses the toothed claw as a sort of comb to clear away the fragments of its food from the bristles surrounding the gape, but this, as shown by Mr. M'Gillivray, is hardly a satisfactory explanation of the facts;—White of Selborne supposed from some of the actions of a Goatsucker observed by him whilst engaged in hawking about after insects, that the bird caught its prey with its foot and afterwards put it into the mouth, and he considered that the serratim of the claw would enable it to grasp a large and active insect more firmly. This view has not been confirmed, and Goatsuckers in captivity have never been seen to take their prey with the foot.

Only a single species of this group is found in Britain; it is the common Goatsucker (*Caprimulgus europæus*, Fig. 287). Like its allies the Swallows, it is a bird of passage in Europe, ariving from Africa about the month of May, and again taking its departure about the end of September. It is found in all parts of Europe and also extends over the whole of the north of Asia. In this country it is found principally in

open grounds, such as commons covered with furze and ferns, generally in the neighbourhood of trees, around which it often flies in the evening in pursuit of insects. Its food consists principally of beetles and moths, frequently of considerable size,—the remains of the common Dor-beetle (*Geotrupes stercorarius*) and of the Cockchafer (*Melolontha vulgaris*) being often found in the stomach. When flying it occasionally emits a shrill whistling cry, but its more common note is a peculiar whirring sound which has been compared to the noise produced by a spinning-wheel. It is to this note that the bird is indebted for its name of Nightjar or Nightchurr. The eggs are laid on the bare ground, usually under the shelter of a bush, or amongst heath or ferns; the eggs are two in number, of a white colour, clouded and veined with gray.

The name of Goatsucker given to this bird is of very ancient origin, being identical in meaning with the *Caprimulgus* of the Romans and the *Ægotheles* of the Greeks. It alludes to a general belief which prevailed amongst the ancients, and has probably come down to our own times, that this bird sucked the teats of goats, and on this account it appears to have borne by no means a good character in former days.

The exotic species of this group agree in almost every particular of their habits with our native species. In North America several species are found. Like the European Goatsucker they are migratory birds, arriving in the United States in May and quitting them in September. Two of them are well known birds by name even in this country, namely the Whip-poor-Will (*Caprimulgus vociferus*) and the Chuck-Will's-Widow (*C. carolinesis*) so called from their peculiar notes, which are said to resemble these words very closely.

A second subfamily is that of the *Podagerinæ*, a group of birds very nearly allied to the true Goatsuckers, but differing from them in the structure of their feet, the tarsi being usually rather long and the inner toe longer than the outer one. The middle toe, as in the Caprimulginæ, has a serrated claw, and the bill is much depressed and weak. These birds are found in South America and Africa, but scarcely anything is known of their habits. The species of the genus *Podager*, the South American forms of the group, are said to fly in large flocks in the day time and to nestle like the Goatsuckers on the ground.

The last subfamily is that of the *Steatorninæ* or Oil birds, in which the bill is strong, curved and hooked, with the gape very wide and the base covered with feathers and bipectinated bristles. This group includes some of the most remarkable birds in the family, and amongst these the *Steatornis caripensis*—the Guacharo bird or Oil bird of South America—must take the first place. It is a large bird, about the size of a fowl, and like the rest of the Caprimulgidæ is strictly nocturnal in its habits, passing the day, and breeding in dark caverns from which it only issues in search of food in the twilight. Its food however is very different from that of its allies; it consists of fruits and seeds; and the Indians assured Humboldt that the bird never pursues insects. The young become exceedingly fat; and at a certain season they are collected by the natives and boiled down for the sake of their oil, which is said to resemble olive oil and to be of such an excellent quality that it will keep for more than a year without becoming rancid. The birds make a horrible noise when their caverns are invaded, and their abodes are generally regarded with a superstitious dread by the Indians, who belive that the spirits of their ancestors dwell in the recesses of the caverns inhabited by these birds; and in their pursuit of the young birds for their "oil harvest," as they call it, they seldom venture far from the entrance. The Guacharo bird is found not only on the continent of South America but also in the Islands of Guadaloupe and Trinidad.

The species of the genus *Nyctibius*, which appear to resemble the common Goatsuckers in their general habits, are found both in America and Africa. One species the *Nyctibius jamaicensis* or Potoo, is said by Mr. Gosse to be rather sedentary in its disposition, perching on a post or dead tree to look out for passing insects, which it captures by a short flight and then returns to its post of observation.

The remainder of the group consists of species inhabiting Australia and the Islands of the Indian Archipelago, which differ in some respects from the true Goatsuckers, especially in their mode of nidification; their eggs are laid either in the holes of trees or on the branches; in the former case they make scarcely any nest. One species, the *Podargus humeralis*, a native of Australia, has the power of shifting the outer toe backwards, and is said to capture its insect prey by creeping about the trees; another, the *Podargus Cuvieri*, is more active, and takes its food on the wing like the other Goatsuckers. It is the *More Pork Bird* of the Australian colonists, so called from a resemblance in its note to the words *more-pork*, and, according to Mr. Gould, it is regarded like the owl, as a bird of ill omen. With these nocturnal Fissirostral birds the great order of Passerine birds concludes, and we pass from them by an easy transition to the Owls or nocturnal birds of prey with which we commence the next order.

## Order VIII.—Raptores.

**General Characters.**—Amongst the Passerine birds we have met with not a few instances of species which are exceedingly predaceous in their disposition, destroying, not only insects and worms, which in fact constitute a considerable portion of the food of most of the species, but also tyrannizing over the smaller birds and other vertebrated animals in a style which would justify us in applying to them the denomination of birds of prey. It is however in the present order that we find the powers of destruction developed to the fullest extent, and the whole structure of the Raptorial birds is evidently adapted to the incessant warfare which they wage with their neighbours. Nevertheless some of these birds are of a peaceful nature, and feed exclusively upon the bodies of animals which they find already dead, although in all their characters they are unmistakeable members of this order.

Amongst these distinctive characters the most important are those furnished by the bill and feet. The former of these organs, is always rather short and strong, with the upper mandible longer than the lower one, strongly hooked at the tip, or curved throughout its whole length, very sharp at the point and frequently armed with teeth on the margins. The base of the bill is covered by a cere in which the nostrils are pierced. The feet are usually short and powerful, composed of four toes, armed with long, curved and acute claws. With these the predaceous birds seize their prey in a deadly grasp, and with these they hold the victim whilst the powerful bill is engaged in tearing off portions of its flesh.

The other parts of their organization exhibit the same adaptation to a piratical mode of existence. The wings are always of large size, and often of extraordinary length, giving the birds an astonishing rapidity of flight; it has been calculated that some of the Falcons progress through the air at the rate of at least sixty miles an hour, under ordinary circumstances, but, when in immediate pursuit of their prey, they are supposed sometimes to attain at least twice this speed. The tail is long and broad, usually composed of twelve feathers; it is sometimes rounded and sometimes forked at the end. The tarsi are rarely furnished with scutella as in the Passerine birds, but these and the toes are generally covered with a reticulated skin, although in some cases a few

scutella are found upon the front of the tarsi and the upper part of the toes. The latter are arranged three in front and one behind, and the anterior toes are usually united at the base by a short membrane, except in the Owls, in which the outer toe is capable of being turned backwards and the inner one alone is united to the middle toe by a membrane. In some instances the feet are feathered down to the toes.

The Raptorial birds are very generally distributed over the globe. They vary greatly in size, but the majority feed upon the flesh of animals which they capture for themselves; some of the smaller species however condescend to prey upon insects.

**Divisions.**—These birds form three families, which may be arranged in two sections or tribes, the Nocturnal and Diurnal rapacious birds. The former of these sections only includes a single family, that of the Owls; the second includes the Vultures and Falcons.

The family of the *Strigidæ* or Owls, is distinguished from the other rapacious birds by many characters both external and anatomical, in fact the peculiarities of their external appearance are so striking that scarcely any one could fail of recognizing an Owl at the first glance. Amongst these superficial characters, those which have reference to the nocturnal habits of the birds catch the eye at once. These consist in the peculiar texture of the plumage, which is exceedingly soft and downy, rendering the flight of the Owls, when engaged in their nocturnal rambles, perfectly inaudible, and in the extraordinary size of the eyes, which are fixed in the orbits in such a manner as to look almost directly forward, and the peculiar vacant stare of which, when the birds are exposed to the light of day, usually give them a most ludicrous appearance. The ears also are of large size (Fig. 289) frequently very large, and often furnished with a sort of operculum or lid. All these characters we have already seen to belong also to a greater or less extent to the Nocturnal Fissirostral birds, forming the family of the Goatsuckers (*Caprimulgidæ*).



Fig. 288.—Head of the Little Horned Owl. (*Scops Aldrovandi*).



Fig. 289.—Head and ear of the Barn Owl. (*Strix flammea*).

The head is always of large size and covered with feathers, which on the face are of a peculiar hairy texture and arranged in a radiating manner round each eye, so as to form a sort of disc on each side of the face. In some cases this radiating arrangement of the feathers extends entirely round the eyes, and the disc is then said to be complete;

but in others the upper part of the disc is wanting and it is then called incomplete. The superciliary ridge which forms the projecting eyebrow in the *Falconidæ*, is wanting in these birds. The bill is short, compressed, curved and hooked at the tip; its base is concealed by projecting bristles and by the facial feathers, and covered by a cere, near the anterior margin of which the large nostrils are situated.

The wings are of moderate length, broad and rounded, and the birds do not possess the power of flight in nearly the same degree of perfection as their near allies the Hawks and Vultures,—and in accordance with this diminution of power in the anterior members, the sternal apparatus is found to be smaller and slighter in its construction than in the other Raptorial birds. The legs however are short, stout and powerful, and



Fig. 290.—Foot of the Long-eared Owl. (*Otus vulgaris*).

the toes are armed with strong acute claws (Fig. 290). The tarsi are almost always clothed with feathers, which also extend nearly to the extremities of the toes, which are here furnished on the upper surface with a few scales; the feathers of these parts are frequently destitute of barbs, so that the feet appear to be covered with hair. The outer toe, as has already been stated, is capable of being turned backwards, so as to give the foot a resemblance to that of a Scansorial bird.

The Owls also differ remarkably in the structure of the intestinal canal from the other members of this order. The mouth is wide and leads into an œsophagus which is also of considerable dimensions, but which leads directly to the stomach, without being dilated into a crop. The intestine is short and furnished with two cœca of considerable size.

With but few exceptions the Owls are strictly nocturnal in their habits, and the more typical species are confused and helpless when exposed by accident to the glare of day. They prey generally upon small Vertebrate animals, principally birds and quadrupeds, and some are also expert fishers. They also share with the Goatsuckers in the destruction of the larger species of night-flying insects, such as moths and large beetles. Their treatment of their prey depends greatly upon its size; if it be small they transfer it at once from their claws to their bill and swallow it whole, but if they sieze upon a booty which is too large to be disposed of in this manner, they carry it off to some resting-place, where they tear it to pieces and thus devour it. The indigestible portions of the prey, such as feathers, bones, &c., are collected into small pellets in the stomach and disgorged.

They are solitary birds, which retire during the day to holes in trees, rocks or old buildings, where they roost and breed. With the twilight their activity commences and they then take their noiseless flight in search of food, and as this consists to a very considerable extent of the small animals which, under the denomination of *vermin*, are generally regarded as enemies to the human race, the Owls should be placed amongst the number of our friends, instead of being looked upon, as they are by many with a superstitious eye, as ominous of some dire calamity. It must be confessed indeed that their voices are none of the sweetest, and the superstitious peasant who hears the Owl shrieking about the village churchyard or in some solitary place, when every other sound is hushed, may perhaps be excused for feeling some little awe on the occasion.

Although these birds are exceedingly similar in their habits, they have been divided into four subfamilies, of all which we have British representatives. The first is that of the *Strigina* or True Owls, in which the head is smooth, destitute of horn-like tufts of feathers, and the facial discs are complete. To this group belongs the commonest of our native species, the Screech or Barn Owl (*Strix flammea*) a permanent resident in these Islands, which is found abundantly in most of the cultivated parts of the country, where the corn-fields and stack-yards furnish it with a plentiful supply of the mice on which it preys. Some idea of the number of these creatures which this Owl destroys, may be formed from the fact that the indigestible remains of eight or ten of them may be found in the stomach at once, and when they have young they are said by Mr. Waterton, to bring in a mouse every twelve or fifteen minutes. According to the observations of the same naturalist, a pair of these birds which he placed in a hole of an old gate-way, had accumulated in sixteen months more than a bushel of pellets containing the skeletons of the mice which they had consumed. Nevertheless as the Barn Owl is supposed to do some little injury to the game, it is exposed to constant persecution at the hands of sportsmen and game-keepers, and its remains may often be seen nailed to the wall amongst the other trophies of the skill and activity of the latter. This bird has also been seen to capture fish by dropping suddenly upon them in the water. The general note of the Barn Owl is a screech, and although some observers have stated that they have heard it hoot in the same manner as some of the other Owls, there appears still to be some doubt upon this subject.

Its nest is made in the hole to which the bird usually retreats to roost. It is of a very slight construction, sometimes scarcely deserving the name of a nest, and in it the bird lays from three to five eggs of a white colour. The breeding season extends over a considerable period, as young birds have been found in the nest as early as July and as late as December. It appears that the eggs of the second and third broods are laid before the young birds of the former broods have left the nest, and it is probable that the warmth of the latter serves materially to assist in the hatching of their younger brethren. In a case of this kind recorded by Mr. Blyth, three broods were observed to be reared in the same nest, which at last contained six young birds of three different ages. The Barn Owl is found in all the temperate parts of Europe, in the southern parts of Asia, and in Africa as far south as the Cape of Good Hope. It is also said to occur in the United States of America,

The species of this sub-family, although not very numerous, are generally distributed in all parts of the globe, but their habits are everywhere nearly the same. A Javanese species, the *Pholidus badius* or Wowo-Wiwi, which resides in the thickest forests of that Island, the haunts of the Tiger, is said by the natives to show the greatest familiarity

towards that formidable quadruped, even alighting on his back; for what purpose is not stated.

The second sub-family is that of the *Otinæ* or Owlets, in which the facial discs are complete or nearly so (Fig. 291), and the head is usually furnished with two small tufts. These small Owls, like the Striginæ, are found in all parts of the world, and the species enjoy a very wide geographical range. Thus the common British species are not only found in all parts of Europe, but also in Asia, Africa and the United States of America, and some of those which occur rarely in Europe, are met with abundantly in the last mentioned locality.

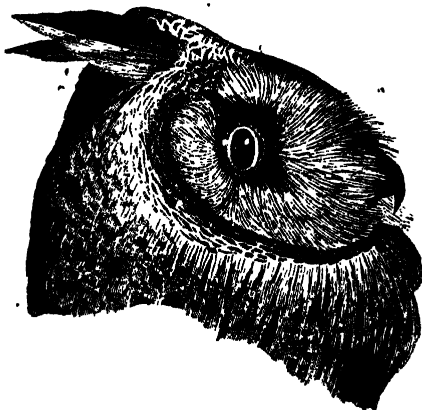


Fig. 291.—Head of the Long-eared Owl (*Otus vulgaris*).

Most of them are strictly nocturnal in their habits, retiring during the day to the shelter of thick woods, and they are said to breed generally in the deserted nests of other birds. One of the British species however, the Short-eared Owl (*Otus brachyotus*), which is not uncommon in many places, especially in winter, is found resting during the day amongst high grass and herbage or in the stubble fields, and its nest, formed of a little dry grass and moss, is placed on the ground in similar situations. This bird is also remarkable in its sub-family from its habit of seeking food by day, and it does not appear to be at all incommoded even by the light of the sun. In the Orkneys, where, according to Mr. Low, it is very abundant, it is exceedingly bold and impudent during the breeding season, stealing chickens from before the doors, pursuing pigeons in the open day, and performing various feats of the same nature which are very unusual with the Owls. The same naturalist states that he found the remains of a grouse in the nest of a bird of this species, although it would seem almost impossible for the little Owl to kill and carry of a bird so much larger and heavier than itself. Its ordinary food however appears to consist, like that of the majority of our Owls, of mice; and when these are abundant the birds have been seen to collect in particular fields in considerable numbers.

It is found in both hemispheres and is recorded to occur in India. In the most northern parts both of the eastern and western continents it is only a summer visitor, and a great number of individuals migrate in the summer from this country to the north of Europe, returning again in the autumn.

The Long-eared Owl (*Otus vulgaris* Fig. 291), is, next to the Barn Owl, the most abundant of the British Owls. It is a permanent resident in this country and does not appear to perform even the partial migration executed by the Short-eared Owl.

To this sub-family also belong the Hooting Owls (*Syrnium*), distinguished from the preceding species by the absence of the ear tufts, of which two species occur in Britain. The commonest of these is the Tawny Owl (*S. stridula*), which inhabits the wooded parts of the country, and always remains concealed during the day, coming forth at night in pursuit of the small animals which constitute its food, and giving utterance to

a most dolorous cry, resembling the syllables *hoo-hoo-hoo.* It feeds on leverets, young rabbits and all the smaller animals, including frogs, insects, and earth-worms, and from the testimony of several observers, it not unfrequently captures fishes in the water. It breeds, according to some naturalists, in the deserted nests of other birds, but also, according to others, in the holes of trees, where it makes little or no nest, and often lays its eggs upon the rotten wood at the bottom of the hole. The Tawny Owl does not appear to occur in America, but in the northern parts of that continent it is replaced by an allied species, the *Syrnium* (*Nyctala*) *Tengmalmi*, of which specimens are occasionally found in Britain and on the continent of Europe, especially in the north. The habits of this species appear to be very similar to those of the Tawny Owl.

In the third sub-family, that of the *Bubonina* or Horned Owls, the facial discs are imperfect, and the head is large and broad, and furnished with a pair of long horn-like



Fig. 292.—Head of the Great Eagle Owl. (*Bubo maximus*).

tufts (Fig. 292). These birds are distributed in all parts of the world. They vary greatly in size, some of them being the largest and others amongst the smallest members of the family of the Owls. They are most abundant in the warmer parts of the world, and of the two well known European species only one extends its range far to the north. This is the great Eagle Owl (*Bubo maximus* Fig. 292), one of the largest species of the group; which measures upwards of two feet in length, and is rendered very remarkable in its appearance by the long horn-like tufts of feathers with which its head is adorned. It is common in the great forests of the continent of Europe, from Sweden, Norway, and Lapland to the shores of the Mediterranean, but is a rare bird in Britain. It occurs also on the continent of Asia, and Mr. Gould, as quoted by Mr.

Yarrell, states that he has seen specimens of this bird in collections from China. This Owl is said not to be strictly nocturnal in its habits, although the night is its period of greatest activity; it feeds upon quadrupeds and birds, especially hares, grouse, and partridges, which its great size enables it to overcome with ease. It builds a bulky nest, usually on a rock or on the ground, and lays two or three white eggs.

An interesting instance of the attachment of these birds to their young, is related by the Bishop of Norwich in his work on birds. A young bird nearly fledged was caught in the month of July and placed in a large hen-coop. On the following morning to the surprise of the captors a fine young Partridge was found lying dead in front of the door of the coop, evidently brought there by the old birds, who had no doubt been engaged during the night in an anxious search for their missing young one. The same mark of attention was repeated every night for a fortnight, but although a watch was kept for several nights it was found impossible to detect the old birds in the act of bringing this supply.

In captivity, the Eagle Owl, like most of the other members of the family, hisses and snaps its bill when irritated and alarmed, but rarely makes any other noise; Sir William Jardine however states that a specimen kept by him was extremely active at night, sometimes keeping up "an incessant bark, so similar to that of a cur or terrier, as to annoy a large Labrador house-dog," whose angry barking at this unwarrantable disturbance appears to have been by no means agreeable to his neighbours.

A nearly allied species, the Great American Horned Owl (*Bubo Virginianus*), an inhabitant of the southern States of the American Union, is described by Wilson as giving utterance to a loud cry of *Waugh O! Waugh O!* "sufficient to have alarmed a whole garrison." The same author adds "He has other nocturnal solos no less melodious, one of which very strikingly resembles the half-suppressed screams of a person suffocating or throttled, and cannot fail of being exceedingly entertaining to a lonely benighted traveller, in the midst of an Indian wilderness." This bird is rather smaller than the European species, with which it was formerly regarded as identical. In its habits it appears to be very similar. The other European species, the Little Horned Owl (*Scops Aldrovandi* Fig. 286), appears to be almost confined to the southern parts of the continent, and it is said to be most abundant in the countries bordering the Mediterranean. Even in these countries, however, it is a bird of passage, and crosses to the African continent at the approach of winter. It is found also in the southern parts of Asia, at least as far to the eastward as India. Specimens have occurred, but very rarely in this country. This bird measures only seven or eight inches in length; its food consists principally of mice and insects; it nestles in the cavities of rocks or in the holes of trees, and lays from two to four eggs.

Amongst the Indian species, which are tolerably numerous, we may notice the *Ketupa flavipes*, which is somewhat diurnal in its habits, and is said to frequent especially the borders of streams, into which it plunges sometimes to a considerable depth in pursuit of fish. The note of an allied species, the *Ketupa ceylonensis* is a hoarse hollow laugh, resembling the syllables *Haw, Haw, Haw, Ho!* which is described as most disagreeable and repulsive. The *Bubo Bengalensis* feeds principally upon rats; and Colonel Sykes has described an instance in which one of these birds was found to have swallowed a rat whole, the head and part of the body being in the stomach and partially decomposed, whilst the tail was still hanging out of the mouth. This species is said to build in trees, forming a nest of sticks.

In the sub-family of the *Surninæ* or Hawk Owls, with which the family of the

Strigidæ concludes, we find an approach to the structure of the Diurnal Raptores. They agree with the Buboninæ in having the facial discs imperfect, but are dis-

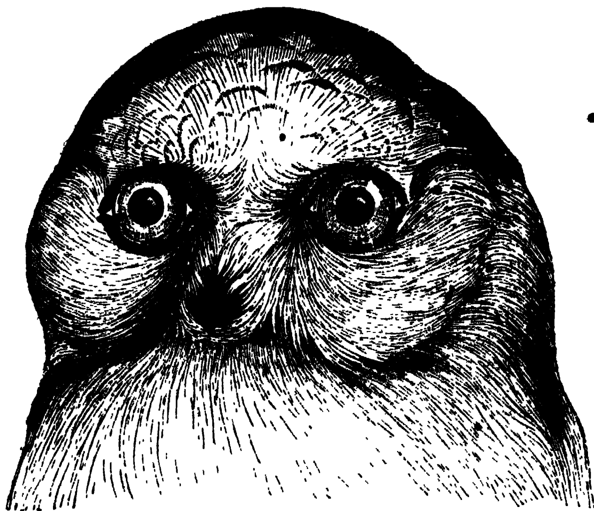


Fig. 293.—Head of the Snowy Owl. (*Surnia nyctea*).

tinguished from those birds by the comparatively small size of the head and the absence of the horn-like tufts. The eyes are also smaller in proportion than in the more typical Owls, and the external ear is smaller and less complicated (Fig. 294). These differences in structure are evidently connected with the diurnal habits of the birds composing this group, which are for the most part confined to the Arctic Regions of both hemispheres, at least during the summer, and as at that season there is no night in those regions, a strictly nocturnal bird would find himself very inconveniently situated. At the approach of winter these birds move a little southwards, and some of the species are then found in Britain and the more temperate parts of Europe.

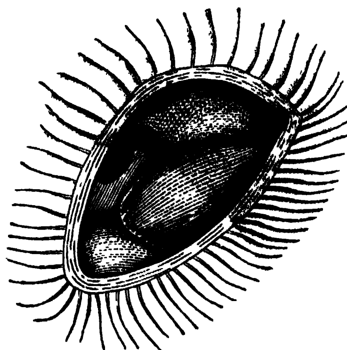


Fig. 294.—Ear of the Snowy Owl.

The best known species is the Snowy Owl (*Surnia nyctea*, Fig. 293), which is said to be a permanent resident and even to breed in the Shetland Isles. Next to the Eagle Owl it is the largest British species of the family; it preys upon birds and small quadrupeds, which it appears to swallow whole. It flies with great rapidity and generally frequents open ground, reposing and

breeding amongst rocks, which harmonize so well with its colour that it cannot be easily detected. The habits of the other northern species appear to be very similar.

The genus *Athene*, belonging to this subfamily, is for the most part confined to the warm regions of the earth. Several species are found in different parts of India, where some of them are very troublesome from the continual noise they make. The cries of one species, the *Athene scutulata*, are said to resemble those made by a cat when undergoing the process of strangulation. They are rather small birds and their food consists principally of mice and beetles.

The most singular species of this genus however is one which enjoys a very extensive range over the continent of America and occurs also in the West Indian Islands. It is the Burrowing Owl (*Athene cunicularia*). In Saint Domingo, where these birds were observed by Vieillot, they dig a burrow of about two feet in depth, at the bottom of which they lay a bed of moss for the reception of their eggs. In the United States however they save themselves this trouble by taking possession of the burrows of the singular Prairie dogs or Marmots, which form their curious villages in many of the western states. In these villages of Marmots the Owls may constantly be seen moving briskly about, but they do not appear to be regarded with very friendly feelings by the rightful inhabitants, of whose dwellings they probably possess themselves by force. They are diurnal in their habits and those which inhabit the United States are said to feed entirely upon insects; but in Saint Domingo and Chili the Burrowing Owls are said to devour rats, mice, and reptiles, which renders it probable that there may be more than one species. The North American bird is about ten inches in length.

The Diurnal Raptores are readily distinguished from the Owls by the smaller comparative size of the head and eyes; by the lateral position of the latter organs and by the nature of the plumage, which is firm and wants that peculiar softness which enables the nocturnal species to fly so noiselessly through the air. Their wings also are usually longer and more pointed, and their power of flight is much greater, and this causes the



Fig. 295.—Head of the Golden Eagle (*Aquila chrysaëtos.*)

sternal apparatus to assume a far more developed form. The bill is strong and usually larger than in the Owls; nearly half the upper mandible is covered by a cere, which is

not concealed by the frontal plumes and bristles. The tarsi and toes are usually covered with reticulated scales, but in some instances are plumed to a greater or less extent. In the structure of the intestinal canal there is also a marked difference between the diurnal and nocturnal Raptores; the œsophagus in the former is dilated into a large sac or crop, which is wanting in the latter; and the cœcal appendages of the intestine, which in the Owls attain a considerable development, are reduced to a very small size in the diurnal species. This group, as already stated, includes two families, the *Falconidæ* and the *Vulturidæ.*

In the family of the *Falconidæ* or Hawks, the head and neck are always clothed with feathers and the eyes are deeply sunk and shaded above by a bony projection or brow. The bill in these birds is short and stout, with the ridge of the upper mandible more or less convex from the base; its tip is elongated, much decurved and very acute, and its lateral margins furnished with a more or less distinct tooth or notch. The base of the upper mandible is covered by a cere, which sometimes covers nearly half the bill and in which the nostrils are pierced.

The wings are of large size, and usually long and pointed; but this character is liable to some exceptions. The tail is always of considerable size, but varies greatly in form. The legs are usually rather short, but very strong and muscular; the tarsus is usually bare of feathers, and covered with reticulated scales, which are frequently replaced by scutella in front; and the toes, which are arranged three in front and one behind, and armed with long curved and very acute claws, present the same superficial characters. The feathers of the outside of the tibiæ are more or less elongated, sometimes very long (Fig. 296.) forming a sort of plume which projects more or less beyond the bend of the tarsus.

Although there are numerous species of these birds, differing greatly not only in size but also in many points of structure, their general habits may be summed up in a few words. They are all remarkably powerful fliers and pursue their prey entirely on the wing. Their food consists of quadrupeds, birds, reptiles, and insects, which they seize by suddenly pouncing down upon them in the air or on the ground; many of the species also feed upon fishes, in pursuit of which they dash down with great force into the water. Their victims are seized by the powerful, curved and acute claws, the deadly gripe of which generally destroys life very rapidly, but the bill is rarely used except to tear the flesh of the prey after it has been secured in the talons. When the animal killed is of small comparative size, the birds generally carry it off to some quiet spot where they may feed upon it without fear of interruption; but when it is too large to be thus disposed of they gorge themselves with its flesh on the spot where it fell. In either case however they usually

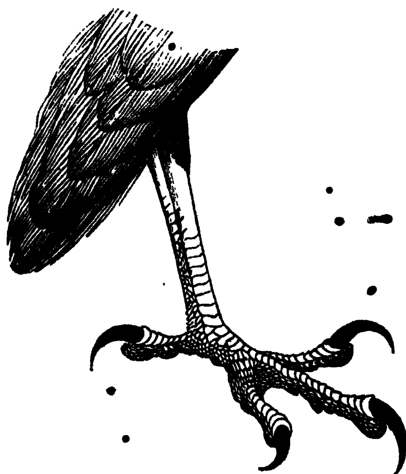


Fig. 296.—Foot of the Hen Harrier (*Circus cyaneus*).

devour as much of their victim as will completely fill the crop or dilated portion of the œsophagus, and then always retire to some sequestered retreat where they remain quiet until the food has digested. They generally remove a good portion of the hair or feathers from their prey before commencing their attack upon its flesh; but, notwithstanding, usually swallow some of these indigestible articles, together with a part of the bones; but all these parts are left behind in the stomach, and vomited in the form of roundish pellets.

Their strong feet enable them to perch with great ease and security, and, when thus resting, they sit with the body nearly erect, and the head and neck drawn back in an attitude of considerable elegance; but on the ground the length and curvature of their claws render them rather awkward; they incline the head and body forward, and are obliged to move by clumsy leaps, with the assistance of their wings.

The Falconidæ are all solitary birds. Their cry is loud and shrill, sometimes becoming a scream or yelp; it is usually a sign of anger or triumph. Their nests are rude, flat, and usually of large size; they are composed of sticks, twigs, and similar materials, and lined with hair, wool, or feathers, in the part destined for the reception of the eggs. These vary in number from two to about eight; they are usually of a white colour, and more or less spotted with darker tints.

The birds of this family were formerly divided into the true or *noble* and the *ignoble* Falcons, the former including those birds which, from their great strength and courage, were commonly employed in the old sport of Falconry; the latter, those Hawks which were of little or no use for this purpose. The noble Falcons correspond pretty nearly with our sub-family of the Falconinæ or true Falcons; and under the designation of ignoble birds all the other Hawks were included. Mr. G. R. Gray divides the Falconidæ into seven sub-families, of which four have the ridge of the upper mandible curved more or less from base to apex, whilst in the remainder the basal part of the ridge is straight, and the tip alone hooked. To these we shall add an eighth group for the reception of the singular Secretary-bird or Serpent-eater of South Africa, which is included by Mr. Gray (in his Genera of Birds) in the sub-family of the *Circinæ*, although in his list of the Genera of Birds he considers it as the type of a distinct family.

Of the former the *Circinæ*, or Harriers,—which have the eyes and ears of larger size than those of the rest of the family,—are considered to approach most closely to the Owls although it does not appear that they are at all nocturnal in their habits. They have the bill short, of moderate strength, and compressed, with the sides sloping, and the lateral margins slightly festooned or sinuated. The wings are long, and more or less pointed, the third and fourth quills being the longest, and the whole of the plumage is soft and downy, somewhat like that of the Owls, the resemblance to which is increased in some species by the presence of a sort of ruff, which runs from behind the eyes to the chin. The tarsi are long and slender, and the toes rather short.

Of this group three species are recorded as British. These are—the Common or Ring-tailed Harrier (*Circus cyaneus*), the Marsh Harrier, sometimes called the Moor Buzzard (*C. æruginosus*), and Montagu's Harrier (*C. cineraceus*). Of these the first only, the Ring-tailed Harrier (*C. cyaneus*, Fig. 297) can be called common; but this species is generally distributed in all parts of the country. In this bird the wings are about two inches shorter than the tail; the male is of a light bluish gray colour, and eighteen or nineteen inches long; and the female, which is about two inches longer than her partner, is brown above and pale yellowish red beneath. The Marsh Harrier

is about two inches longer than the Common Harrier; it is by no means abundant, although it occurs in most parts of England and Wales. Montagu's Harrier is rather smaller than the common species, from which it is easily distinguished by the great length of the wings, which reach to the extremity of the tail. This bird also occurs in various parts of England, but is not very plentiful.



Fig. 297.—Head of the Common Harrier (*Circus cyaneus*).

The Harriers in general feed upon small quadrupeds, such as young hares, rabbits, rats, &c., birds, reptiles, and sometimes insects and fishes. When searching for their prey, they fly gently along, at a small elevation, and appear to beat over every part of the surface of the ground like a dog hunting for game; to this habit, no doubt, they are indebted for their name of Harriers. They usually pounce upon their prey upon the ground, but some species will pursue birds upon the wing, and the Common Harrier has been seen to capture Partridges in this manner. They are found in both hemispheres, and appear to migrate towards the warmer regions of the world at the approach of winter. They roost and nestle on the ground, usually amongst furze or heath, and the nest is composed merely of a few sticks with a slight lining of grass; sometimes even this scanty provision is dispensed with, and the eggs are laid on the bare ground. Occasionally, however, the nest is raised a little from the ground in a bush. The eggs are three or four in number.

Nearly allied to the Harriers is the sub-family of the *Serpentarinæ*, or Serpent-eaters, which only includes a single species,—the Secretary-bird (*Serpentarius reptilivorus*). This remarkable bird is at once distinguished from the other Falconidæ by the great length of its tarsi, which raise the bird to such a height from the ground as to give it rather the appearance of a Grallatorial than of a Raptorial bird; in fact, by some authors it has been placed amongst the Grallatores, and by others amongst the Gallinæ. The whole structure of the bird, however, proves that it really differs from the other rapacious birds only in the length of its legs.

The Secretary-bird is found in the dry plains of South Africa, where it wages a constant war with the snakes and other reptiles which abound in that locality. The wings are of large size, and armed with blunt spurs at the wrist joint, and, when approaching a serpent, the bird holds one of its wings in front of it like a shield, and keeps it in continual agitation. At the moment when the snake is about to spring upon his assailant, the bird strikes a sudden violent blow with his wing, which usually lays his prey prostrate upon the ground, although it is probable that a large snake may sometimes require two or three repetitions of this treatment before he is reduced

to a helpless condition. When this is effected, the bird has been seen to take his victim up in his beak and claws, and carrying him up to a considerable height in the air, let him fall upon the ground to complete his destruction. So great is the voracity of this bird that Levaillant mentions his finding in the crop of one of them no less than eleven good sized lizards, three serpents as long as his arm, and eleven small tortoises, besides a number of insects of different kinds.

The Secretary-bird must, accordingly, be regarded as a great benefactor to the inhabitants of the countries in which he resides; and, in fact, his good qualities are so well known to them, that it is said they not unfrequently introduce him into the poultry-yards, where he does good service by the destruction of snakes, rats, and other vermin, and rarely attacks his feathered neighbours unless the supply of his legitimate wants has been neglected. The French also have attempted to introduce the bird into their island of Martinique, where it was hoped he might be serviceable in the destruction of the dreaded *Fer-de-Lance* serpent (*Trigonocephalus*).

This bird is said to build its nest in high trees, and sometimes in thickets. It is of considerable size, measuring nearly three feet in height; and its appearance is rendered remarkable by an erectile crest which hangs from the back of its head, and which, from its resemblance, when in repose, to a pen stuck behind the ear, has obtained for the bird its name of the *Secretary*.

The third sub-family is that of the *Accipitrinæ*, or Sparrow Hawks, in which the bill is short and stout, with the sides rather convex, and the lateral margins strongly festooned. The wings are of moderate length, or rather short, with the fourth and fifth quills usually longest; the tail is broad and rounded; the tarsi are rather long, slender, and scutellate in front, and the claws are long, curved, and very acute.



Fig. 298.—Head of the Sparrow-Hawk (*Accipiter nisus*).

The *Accipitrinæ* are elegant, slender birds, which are very generally distributed over the surface of the globe. They vary considerably in size, and the difference in this respect between the sexes is often very great, the male of some species, such as the Goshawk (*Astur palumbarius*), being occasionally as much as one-third less than the female. When seeking their prey, they fly rapidly along at a small elevation, and pounce down immediately upon any small animal which they spy upon the ground. They also capture birds upon the wing, and will dash in amongst the branches of trees with the greatest impetuosity in pursuit of their prey. They generally build their

nests in trees, but in countries destitute of wood will nestle upon the rocks. The nest is very rude, formed of twigs with a small quantity of some softer materials; and the eggs, which are of large size, and spotted, are from three to five in number. Not unfrequently these Hawks take possession of the deserted nest of a crow or some other large bird, and thus save themselves the labour of building.

In this country we have only two species of this group, one of which, the Common Sparrow-Hawk (*Accipiter nisus*, Fig. 298), is perhaps the most abundant of our native Hawks, whilst the other, the Goshawk, is one of the rarest. The Common Sparrow-Hawk is an elegant little bird. The male measures about twelve inches in length, and the female about fifteen. It is an exceedingly bold and active bird, darting along with wonderful rapidity, and performing the most astonishing evolutions during its flight in pursuit of its prey. This consists of almost any small animals that may come in its way; all the small birds live in constant dread of this little tyrant; but it is not always contented with this game, but will seize boldly upon leverets, young rabbits, and partridges. At other times it will stoop to prey upon field mice. Occasionally the Sparrow-Hawk will visit the farm-yard, and carry off chickens or pigeons, to the great disgust of the careful housewife, whilst its depredations amongst the game render every gamekeeper its sworn foe, and its weather-beaten body is often seen amongst the other trophies of his vigilance.

The Goshawk (*Astur palumbarius*) is much larger than the Sparrow Hawk, the female measuring about twenty-four or twenty-five inches in length. It is a very rare bird in this country, but occurs abundantly in many parts of Europe; it is also found in the north of Africa, and a bird supposed to be identical with it is an inhabitant of North America. It resembles the Sparrow Hawk in its general habits, but from its greater size and strength it is a much more formidable bird. In the olden time, when falconry was a favourite sport, the Goshawk was held in great esteem; it was flown at Pheasants, Partridges, Grouse, Ducks, and Herons, and also at Hares and Rabbits. It is still trained in the East Indies, where it is called the *Bhause*. In pursuit of its quarry it does not rise above it, and then pounce down in the manner of the true Falcons, but flies after the game in a direct line, a method of capturing its prey which, in the technical language of falconry, is called *raking*. It has another quality not possessed by the true Falcons, namely, that it will follow the quarry through woods and thickets; but it is soon tired of the pursuit, and when eluded by its prey will perch upon the bough of a tree until some fresh game presents itself. It is said that when the quarry takes refuge in a thicket the Goshawk will take its station in the neighbourhood, and watch patiently until its prey is compelled to move by the pressure of hunger.

These are the only species found in Europe, but the exotic species are tolerably numerous. South America particularly appears to possess a great many birds belonging to this group, and several species are inhabitants of Australia. Amongst the latter one beautiful species, the *Astur Novæ-Hollandiæ*, is generally of a pure white colour.

In India, where falconry is still a favourite amusement, one or two species of this group are trained for this sport. The commonest of these is the Shikra (*Micronisus badius*), which is said by Mr. Jerdon to be more frepuently trained in India than any other Hawk. The Besra (*Accipiter virgatus*) is a less abundant bird, but is in high esteem amongst the native falconers. These birds, and also some of the true Falcons, are often taken by a snare called the *do guz*, which is thus described by Mr. Jerdon:—"This is a small thin net from four to five feet long, and about three feet broad,

stained of a dark colour, and fixed between two thin pieces of bamboo by a cord on which it runs. The bamboos are fixed lightly in the ground, and a living bird is picketed about the middle of the net, and not quite a foot distant from it. The Hawk makes a dash at the bird, which it sees struggling at its tether; and in the keenness of its rush, either not observing the net, from its dark colour, or not heeding it, dashes into it, the two side sticks give way, and the net folds round the bird so effectually as to keep it almost from fluttering." An Indian species of Goshawk (*Astur trivirgatus*), inhabiting Assam, is said by M'Clelland to haunt the water-side, and to seize such fishes as come to the surface.

In the *Milvinæ*, or Kites, the bill is rather straighter than in the Sparrow-Hawks; it is short, usually stout, and compressed towards the tip, with the sides slightly convex, and the lateral margins more or less festooned or sinuated, but generally in a less degree than in the preceding sub-family. The tarsi are short and stout, but the wings and tail are very long, the former being pointed and the latter more or less forked.

The Kites are inhabitants of all parts of the globe, but appear to be more abundant in the warmer than in the temperate regions. Only two species occur commonly in Europe; these are the Common Kite (*Milvus regalis*, Fig. 299) and the Black Kite



Fig. 299.—Head of the Kite (*Milvus regalis*).

(*Milvus niger*). The latter is found only on the continent, and principally in the southern parts; but the Common Kite also occurs in these islands, although in the present day it is by no means abundant here. The Kite is rather a large bird, the male measuring about twenty-five and the female twenty-seven inches in total length. The extent of wing is upwards of five feet. Its flight, as might be expected from the great size of the wings, is remarkably powerful and elegant; and it frequently glides along with the wings outspread and motionless, and hovers in the air over a particular spot for a considerable period. The food of the Kite consists for the most part of small quadrupeds, young birds, and reptiles, which it captures on the ground; it also occasionally feeds upon insects, worms, and even carrion. Kites have also been seen fishing very successfully, rarely missing their aim.

In courage the Kite is far inferior to many of the smaller Hawks, and the common Sparrow-Hawk will attack and beat it with ease. The falconers of Louis the Sixteenth of France were in the habit of obtaining a powerful species of Falcon called the Lanner (*Falco lanarius*) to pursue the Kite, and that sovereign is said to have been highly amused with the sport. Hence the name of *Milan royal* was given to the Kite by the French naturalists, and from this the specific name of *regalis* is derived. The same sport has been followed, according to Sir John Sebright, in this country; a great Owl is sent up, with the tail of a Fox tied to its legs, and when the Kite approaches to get a nearer view of this singular animal, the Owl is secured, and the Falcon is sent in pursuit.

The nest of the Kite is formed of sticks, lined with soft materials, and usually placed on the forked branch of a tree in some thick wood. The eggs are two or three in number, of a short, broad form; their colour is white, with a few reddish-brown spots at the larger end.

The American Swallow-tailed Hawk (*Nauclerus furcatus*), a native of the tropical and warmer temperate parts of America, which is distinguished by the great length and furcation of its tail, has been on two occasions shot in this country. It cannot, of course, be regarded as a native bird; and considering that even in summer it does not extend beyond the warm southern states of the American Union, the mere fact of its occurrence in Britain is very extraordinary. In its general habits the Swallow-tailed Hawk presents a good deal of resemblance to our European Kite; but at the same time it is remarkable that with the forked tail it puts on somewhat of the habits of the Swallows, and feeds to a considerable extent upon insects, which it captures in the air. Besides these its food appears to consist principally of snakes and other reptiles. Like the Swifts, also, these birds are said to carry on their courtships in the air. Another American species, the Mississippi Kite (*Ictinia Mississippensis*), is also described by Wilson as indulging to a great extent in insect food, which it captures in the air in the same way as the Swallows.

We have already stated that the Common Kite will feed on carrion; and according to Clusius, a foreign botanist who visited London in the reign of Henry the Eighth, the streets of the city were then infested by an immense number of Kites, which came there for the sake of the offals which were thrown into the streets. They were so tame that they did not allow themselves to be disturbed at their meals even by the busiest crowds, and their services as scavengers were so highly appreciated, that the people were forbidden to kill them. The Kites would get but a poor living in the streets of London at the present day; but the office of scavengers is still performed in Abyssinia

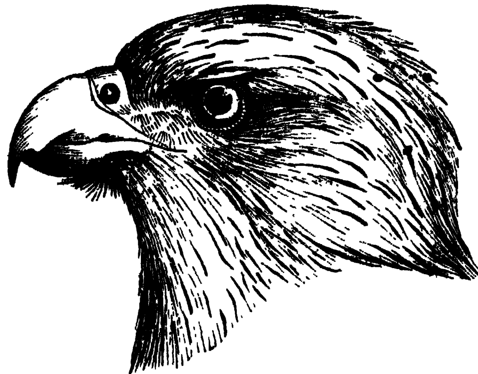


Fig. 300.—Head of the Gyrfalcon (*Falco gyrfalco*).

by the Black Kite (*M. niger*), and in India by the Govinda Kite (*M. govinda*). The latter is very numerous in Calcutta, where it will stoop down in an instant after any garbage that may be thrown into the street, seizing the fragments without alighting, and carrying them up into the air. It will also alight amongst the Crows, to feed upon any larger pieces of carrion; and the alliance between these scavengers is rarely broken, although it is said that sometimes, when very hungry, a Kite will seize upon a Crow. The Govinda Kite is exceedingly bold, descending upon his food in the midst of the most crowded street, and occasionally even stooping upon a dish of meat in its way from the cook's shop.

We come now to the family of the *Falconinæ*, including the True or Noble Falcons, which are distinguished from all the other members of the family by the existence not only of a slight festoon or sinuosity on the lateral margins of the upper mandible, but also of an acute tooth on each side towards the apex. The wings in these birds are very long and pointed, the second and third quills being the longest; the tail is long and rounded; the tarsi of moderate length, stout, and reticulated; and the toes usually elongated, and terminated by long, curved, and acute claws (Fig. 301).

The Falcons are found in all parts of the world, and the number of species is very considerable. They are generally of small or moderate size, but exceedingly powerful and muscular. Their flight is very swift and their courage probably greater than

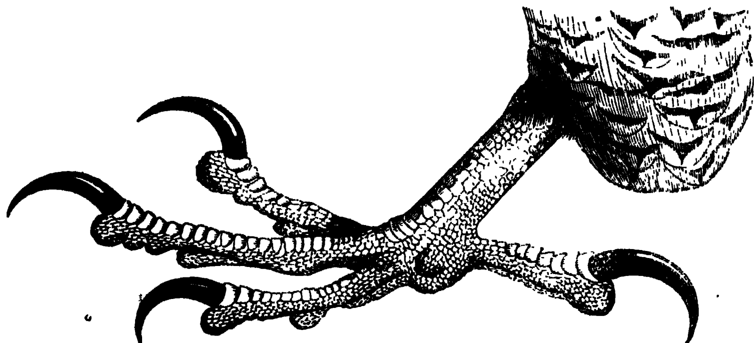


Fig. 301.—Foot of the Peregrine Falcon (*Falco peregrinus*).

that of any other rapacious birds. Their flight is performed by regular, continuous beats, with little or none of that sailing motion which we have seen to be characteristic of the Kites; and in capturing their prey, whether in the air or on the ground, they descend perpendicularly upon it. Their food consists, for the most part, of small quadrupeds and birds, but many of them also feed partly upon reptiles and insects. Their cries are usually loud and piercing.

Their nests are bulky, composed of sticks and twigs, and placed either on the ground, in rocks, or in trees; their eggs, which vary from three to six in number, are generally speckled with red or brown.

In this country we have six species of this sub-family. Of these, the largest and finest species is the Gyrfalcon, Jerfalcon, or Iceland Falcon (*Falco gyrfalco*, Fig. 300), a bird of from twenty to twenty three inches in length, white, with the whole upper part of its plumage marked with dark gray spots; the bill is blue, and the cere and feet yellow, the

tarsi being clothed with feathers about half way down. This large and powerful Falcon is found in all the northern parts of both hemispheres, but it is most abundant in the colder regions, of North America. It appears always to have been a scarce bird in this country, for, in the palmy days of falconry, great sums were expended in procuring these birds from Norway and Iceland; but in the opinion of falconers the birds from the latter country belonged to a distinct species, which they called the Iceland Falcon. From the great strength and courage of the Gyrfalcon, they were used in the pursuit of large birds, such as Cranes, Storks, Herons, and Wild Geese. In the territories of the Hudson's Bay Company, according to Dr. Richardson, it usually preys on the Ptarmigan, but also destroys Plovers and Ducks, and will even attack Geese.

The Peregrine Falcon (*Falco peregrinus*, Fig. 302), the second in point of size of our British Falcons, is perhaps the most elegant of them all. The female measures about twenty inches in length, and was distinguished, in the language of falconry, as the Falcon *par excellence*. Her strength and courage rendered her a very formidable bird, and she was commonly flown at Herons and Ducks. The male Peregrine, from his being sometimes as much as one-third less than the female, was known as a Tiercel or Tiercelet; he was usually employed in the chase of Partridges. This bird is far more abundant and generally distributed than the Gyrfalcon; but, nevertheless, when possessed of all the most esteemed qualities, they were very highly valued by the old falconers; and in the reign of James the First, Sir Thomas Monson is said to have given the enormous price of one thousand pounds for a couple (or *cast* as it is termed) of Hawks.



Fig. 302.—The Peregrine Falcon (*Falco peregrinus*).

The Peregrine Falcon breeds on the ledges of high rocks on various parts of the coast, but is more abundant in the northern parts of these islands. It is found, not only in all parts of Europe, but also in north America.

In a state of nature, the food of the Peregrine Falcon consists principally of birds, especially Grouse and Partridges; but when it lives in the vicinity of water, aquatic birds constitute the principal part of its diet, and it is said to dart down upon these and snatch them up from the surface of the water in a most surprising manner. Its daring is very great. It has often been known to snatch away birds just shot, from before the face of the sportsman; and a still more striking instance of this disregard of danger, is related by Mr. Thompson, of Belfast, who states that a gentleman in that neighbourhood, when out exercising his dogs preparatory to Grouse shooting, "saw them point, and on coming he startled a male Peregrine Falcon off a Grouse (*Tetrao Scoticus*), just killed by him; and very near the same place he came upon a female bird, also on a Grouse. Although my friend," says Mr.

Thompson, "lifted both the dead birds, the Hawks continued flying about, and on the remainder of the pack, which lay near, being sprung by the dogs, either three or four more Grouse were struck down by them, and thus two and a half or three brace were obtained by means of these wild birds, being more than had ever been procured out of a pack of Grouse by his trained Falcons."

The training of these birds for the purpose of falconry, is a work of considerable labour and patience; and in former days the falconer was an important officer about the courts of princes and the households of nobles in all parts of Europe. It is remarkable that, according to Sir John Sebright, who wrote on falconry in 1826, the village of Falconswaerd, near Bois-le-Duc, in Holland, has for many years furnished falconers to the rest of Europe, and he adds that he never met with one who was not a native of that place.

The branch of falconry in which our forefathers appear to have taken the greatest delight, consisted in flying the Hawks at Herons, which is thus described by Sir John Sebright.—"A well-stocked Heronry in an open country is necessary for this sport, and this may be seen in the greatest perfection at Didlington in Norfolk, the seat of Colonel Wilson. This Heronry is situated on a river, with an open country on every side of it. The Herons go out in the morning to rivers and ponds at very considerable distances, in search of food, and return to the heronry towards the evening. It is at this time that the falconers place themselves in the open country, down wind of the heronry; so that when the Herons are intercepted on their return home, they are obliged to fly against the wind to gain their place of retreat. When a Heron passes, a cast of Hawks is let go. The Heron disgorges his food when he finds that he is pursued, and endeavours to keep above the Hawks by rising in the air; the Hawks fly in a spiral direction to get above the Heron, and thus the three birds often appear to be flying in different directions. The first Hawk makes his stoop as soon as he gets above the Heron, who evades it by a shift, and thus gives the second Hawk time to get up, and to stoop in his turn. In what is termed a good flight, this is frequently repeated, and the three birds often mount to a great height in the air. When one of the Hawks seizes his prey, the other soon *binds to him*, as it is termed, and buoyant from the motion of their wings, the three descend together to the ground with but little velocity. The falconer must lose no time in getting hold of the Heron's neck when he is on the ground, to prevent him from injuring the Hawks. It is then, and not when he is in the air, that he will use his beak in his defence."

A third species is the Hobby (*Falco subbuteo*), which presents a great general resemblance to the Peregrine Falcon, but measures only from twelve to fourteen inches. The flight of this bird is very rapid, and it was formerly employed in the pursuit of small birds. In a state of nature its food consists principally of small birds and insects; but Skylarks are said to form its favourite prey. It is a summer visitor to this country, and is not very abundant here; but it appears to be distributed over nearly the whole of the Eastern Hemisphere. It builds its nest in trees, and lays three or four eggs of a bluish-white colour, blotched with greenish-brown. Occasionally it dispenses with the trouble of building, and takes possession of the deserted nest of a Crow.

The Merlin (*Falco æsalon*) is the smallest of the British Falcons, measuring only eleven or twelve inches in length. It is not uncommon in the northern parts of this country, especially in the winter, and it was long supposed to be a winter visitor, but it is now ascertained to remain all the year and breed in Scotland. Its courage is very great, and as it is also very docile, it was formerly in much request for flying at small

birds, which constitute its principal food in a state of nature. It will, however, occasionally kill Partridges, although these birds are at least twice its weight. It builds its nest upon rocky ground, or amongst heath, and the eggs, which are three or four in number, are of a reddish-white colour, dotted and spotted with dark red. The Merlin occurs in all parts of Europe, and also in Western Asia. According to Dr. Andrew Smith, it occurs also in Africa as far south as the Cape of Good Hope; and Sir John Richardson obtained specimens in the fur countries of North America, but it does not appear to be known in the United States.

Of the two other British species of true Falcons, one, the Red-legged Falcon (*Falco vespertinus*) is the rarest of the British species of this sub-family. It is common in many parts of the continent, but only a few specimens have been shot in this country. The other, the Kestrel (*F. tinnunculus*), on the contrary, is one of the commonest species of the whole family, occurring abundantly in all parts of the country. It is a beautiful little bird, measuring only thirteen or fourteen inches in length; its food consists principally of Field-mice and Shrews, of which it destroys great quantities. It may for this reason, be regarded as one of the benefactors of the husbandman; but, nevertheless, from its being commonly confounded with the Sparrow Hawk, it is subjected to a war of extermination from the gamekeepers in all parts of the country. Besides the small mammalia just mentioned, the Kestrel also feeds occasionally upon small birds, and the remains of insects and earthworms are often found in its stomach. Mr. Selby, indeed, mentions, on the authority of on eye-witness, that a Kestrel has been seen late in the evening hawking about after Cockchafers—he dashed amongst the insects, seizing one in each foot and then eating them on the wing.

The flight of the Kestrel when searching for its favourite food, is very peculiar. It flies gently along at some thirty or forty feet from the ground, but stops every now and then and remains perfectly stationary, hovering in the air and minutely inspecting the ground beneath it. Should no motion in the grass betray the presence of its prey, it moves on a little further and again repeats its manœuvres: but as soon as its quarry comes into view, the wings and tail are closed in an instant, and the bird falls like a stone upon its victim. Just as it reaches the ground, however, the wings and tail are again expanded, the Kestrel clutches its prey, and usually goes off with it at once to some place where it can devour it without fear of interruption. This habit of hovering in the air, which, although it is common to many other Hawks, is possessed in the greatest perfection by the Kestrel, has obtained for it, in some parts of England, the name of the Windhover. The bird is common in almost all parts of the Eastern Hemisphere.

In the east, where falconry is still a favourite sport with the natives of rank, many species of these birds are trained for this purpose. Amongst these our Peregrine Falcon takes a very high place, but it is considered inferior to a nearly allied species, the *Falco peregrinator*, which is called the Shaheen or Sultan Falcon. It is generally used in the pursuit of the Partridge and the Florikin (*Otis aurita*), a species of Bustard which is common in India; and, instead of being cast from the hand like the Peregrine Falcon, is trained to fly in circles high over the heads of the falconers until the game is started, when it descends upon the quarry with the velocity of an arrow. Several other large species of Falcons are used in falconry in different parts of India. The best known of these is the Luggur or Juggur (*F. juggur*), which is usually slipped from the hand in pursuit of Partridges, Florikins, and even Herons. The Lanner (*Falco lanarius*), another large species, was formerly imported into Europe from the East, and trained to

the pursuit of Kites. Several small species are also trained in that country, and amongst these the birds of the genus *Hierax*, some of which are scarcely bigger than a Thrush, are distinguished for their courage. These are employed in the pursuit of Quails and other birds of corresponding size, and the mode in which they are started after their game, as described by Captain Mundy, is rather curious. "The falconer holds the little well-drilled savage within the grasp of his hand, the head and tail protruding at either end, and the plumage carefully smoothed down. When he arrives within twenty or thirty yards of the quarry, the sportsman throws his Hawk, much as he would a cricket-ball, in the direction of it. The little creature gains his wings in an instant, and strikes his game after the manner of a Bhause." The Bhause is the same as our Goshawk.

From the powerful and courageous Falcons we pass to the subfamily of the *Aquilinæ*, or Eagles, which include the largest species of this family; the habits of these birds are, however, not so strictly predaceous as those of the Noble Falcons, and their courage is decidedly less. In these fine birds the bill is of moderate length, with the ridge of the upper mandible straight from the base at least as far as the end of the cere, beyond which it is decurved; the tip is strongly hooked and acute, but is destitute of the strong tooth characteristic of the True Falcons, and the lateral margins are more or less festooned. The wings are long and usually pointed, with the third, fourth, and fifth quills longest; and the tail is long, broad, and rounded. The tarsi are rather long, but vary greatly in their clothing, being sometimes covered only with scales of various forms, and sometimes completely clothed with feathers. The toes are

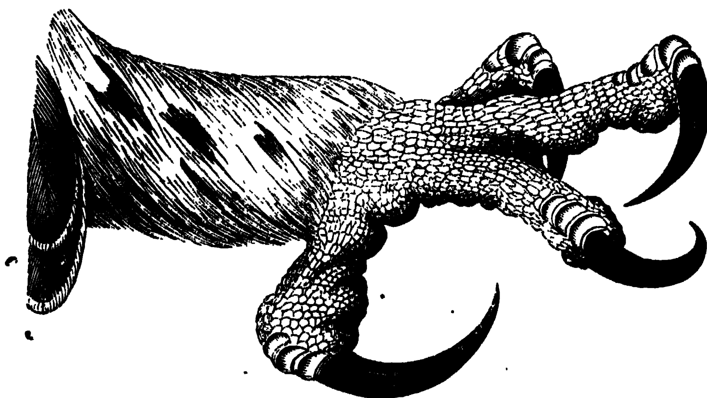


Fig. 303.—Foot of the Golden Eagle (*Aquila chrysaëtos*).

long and powerful, the inner one being usually stronger than the outer; they are all armed with long, strong, greatly curved, and very acute claws.

The Eagles are all birds of considerable or large size, and the bulk of their prey is in accordance with their great powers of destruction. Thus they not only capture the same small animals which constitute the principal food of the smaller Hawks, but they extend their depredations to creatures whose size would prevent the Falcons from attacking them, such as full-grown hares and rabbits, lambs, fawns, and black game. They are also generally much less choice in their food than the True Falcons; and,

notwithstanding the popular belief that they will eat nothing but what they kill themselves, it is well known that they will condescend to feast not only upon fresh dead animals, but also sometimes upon carrion.

The Eagles build their nests, or *eyries* as they are called, composed of a great mass of sticks and similar rough materials, either upon the ledges of rocks or amongst the branches of high trees, but generally in the most inaccessible situations; some of the species appear to be indifferent as to which of these positions they select for their nests, but others are more particular, and some are remarkable for always returning to the same spot for the purpose of breeding. Their eggs are generally two in number, of a whitish colour, more or less spotted, especially towards the larger end.

The finest of the British species, and perhaps the finest species of the group, is the well-known Golden Eagle (*Aquila chrysaëtos*, Fig, 295), which, although it is slightly exceeded in size by some of its relatives, is certainly inferior to none in grandeur of appearance. It is a large bird, measuring about three feet in length and seven or eight feet in extent of wing; its form is robust, and its feet especially indicate enormous power. In all ages the magnificent aspect of the Eagle has gained him the admiration of mankind; and, like the Lion among quadrupeds, he has always been regarded as the type or symbol of majesty and power. Nevertheless, this bird is undoubtedly inferior in courage to many of his smaller brethren, the Falcons. The Peregrine Falcon will dash boldly out upon the Eagle to drive him from the vicinity of her nest, and even the little Sparrow Hawk will sometimes strike at his gigantic relative. The Golden Eagle builds its nest on the ledges of rocks, usually at a distance from the sea-shore, and its food consists for the most part of the flesh of birds and quadrupeds, which it captures for itself. It sometimes destroys lambs of several weeks old, and young fawns, and its strength is so great that it can carry these large objects to its nest with little or no difficulty. Although its food is generally obtained by its own exertions, the Eagle does not disdain to make a meal upon the carcase of a sheep or other large animal which may be exposed upon the hills; and it is not unfrequently led to its destruction by the exposure of a carcase in the neighbourhood of a pit in which the sportsman lies concealed with his gun. When it visits the coast, also, it is said to feed freely on dead fish; and in winter, when food is scarce, its stomach will even bear carrion.

The Golden Eagle is a solitary bird, and always inhabits the wildest parts of the country, far from the ordinary habitations of men. Here he is seen flying majestically along at a considerable height, sometimes advancing by regular beats of the wings, sometimes sailing with the wings extended, and occasionally wheeling about in great circles. During these evolutions he is engaged in looking out for his prey, and as soon as this is perceived he dashes down upon it with the rapidity of thought, seizes it in his talons, and spreading his wings again at the proper moment, rises with it into the air without touching the ground.

The Golden Eagle attains a great age, and one is said to have died at Vienna which had lived in confinement for one hundred and four years. Other statements would give a much longer life to this bird, but these must be received with great caution. Its cry is a sharp yelping scream. Its ferocity in confinement is usually very great, and it is a general opinion that the Eagle is irreclaimable; it is, however, more tractable in confinement than some other species of Eagles, and several instances are on record of its being trained to capture game in the manner of a Falcon.

This bird is very generally distributed; and although apparently more abundant in

the northern parts of the world, it is by no means confined to the cold regions. It is found in all parts of Europe, in the north of Africa, in Western Asia, in India, and also in North America, especially towards the Arctic regions. A nearly allied, but much smaller species, the Rough-footed Eagle (*A. nævia*), an inhabitant of Central and Southern Europe, and of Asia as far as India, has also been killed in this country. Another allied species, the *Aquila Bonnellii*, is found in Asia and the South of Europe, and several others are found in different parts of the Eastern Hemisphere.

The species of the genus *Circaëtus*, of which one (*C. gallicus*) is found in the South of Europe, are well known in India as destroyers of snakes and lizards; according to Mr. Blyth, the *Circaëtus cheela*, which is very common in Lower Bengal, preys much upon frogs, which it clutches in the mud surrounding the tanks.

Besides the Golden Eagle there are two British species of this family, both of which feed to a great extent upon fish, and for this reason are always met with in the neighbourhood of water. One of these, the White-tailed Sea Eagle (*Haliaëtus albicilla*), is rather larger than the Golden Eagle, but exhibits a smaller extent of wing, and wants a great deal of that boldness and intelligence of appearance which has doubtless had much to do with the high reputation of the Golden Eagle. This bird always builds upon the ledges of rocks which overhang the sea, generally in very inaccessible situations; the nest is composed of sticks, sea-weeds, and similar coarse materials.

Large and powerful as is the White-tailed Eagle, he rarely ventures to attack any animal larger than a hare. He feeds readily, however, upon the carcases of sheep, fawns, and other large animals, which may have died from disease or the severity of the weather; and carrion appears to form a considerable portion of his nourishment. Stranded fish are also attacked by him, and he is said by some occasionally to capture fishes at the surface of the open sea, and to watch on the banks of lakes and rivers and attack the Salmon and Trout when they come into shallow water.

Very nearly allied to this is the American White-headed or Bald Eagle (*Haliaëtus leucocephalus*), which has been adopted as the emblem of the United States. This fine bird is rather larger than the British species, and exceeds it considerably in the extent of its wings. It is generally found in the neighbourhood of water, either on the sea coast or on the banks of the lakes and rivers; and one of its favourite stations is said by Wilson to be the Great Falls of the Niagara, where, in company with Vultures and Ravens, it feeds plentifully upon the carcases of animals which are carried down by that tremendous cataract. The Bald Eagle, like its European congener, is exceedingly partial to fish, and in procuring these he employs a stratagem which shows him to be possessed of a good deal more courage than the White-tailed Eagle. Perching on the limb of a tree which gives him a good view of the neighbouring shore and ocean, he watches the evolutions of the Osprey or Fish Hawk (*Pandion Haliaëtus*) until he sees this industrious fisher plunge down into the waves, and emerge again struggling with his finny prey. In a moment the Eagle dashes off into the air in pursuit of the Fish Hawk, which, encumbered with his prey, is no match in flight for his pursuer. The evolutions of the birds, each endeavouring to get above the other, are described as exceedingly interesting; but the result is almost always the same, the Eagle overtakes the Fish Hawk, who, finding himself unable to escape, utters a sudden scream and drops the fish, when the Eagle descends with wonderful rapidity and seizes the booty before it reaches the water. Scenes of this description are said by Wilson to be of daily occurrence along the Atlantic sea-board of the United States; but he adds that the

plunderer is occasionally driven from particular spots by the united hostilities of all the Fish Hawks in the neighbourhood, when, being forced to hunt for himself, he usually directs his course inland, and often makes great havoc amongst domestic animals, especially young pigs. He is also destructive to lambs, and has been known to attempt the abstraction of a child, in which, however, he was disappointed, as, after dragging the infant several feet, its frock, which was fortunately all that he had in his talons, gave way, and thus, no doubt, saved the child's life. The Golden Eagle has also been charged with carrying children away to its nest; but some naturalists regard these tales as very doubtful. The Bald Eagle breeds in tall trees, and returns every year to the same nest for the purpose of breeding. The nest is composed of sticks, sods, moss, &c., and being added to every year soon becomes a prominent object. The bird lays two eggs, but it is said that one of them is laid a considerable time after the other, so that the warmth of the first hatched young bird assists materially in the development of the second chick. The attachment of these birds to their young is very great, and Wilson mentions an instance in which, when a tree bearing an Eagle's nest, was set on fire, the parent bird was so much injured by the flames in her attempts to relieve her progeny, that it was with difficulty that she made her escape.

The Osprey or Fish Hawk (*Pandion Haliaëtus*, Fig. 304), above referred to, although most abundant on the coasts of North America, is also well known on this side of the



Fig. 304.—Head of Osprey (*Pandion Haliaëtus*).

Atlantic, and, in fact, appears to exist almost all over the world; but it is a migratory bird in the temperate and colder regions. It is about two feet in length and five or more in extent of wing, so that, although it is no match for the great Bald Eagle, it is a sufficiently formidable bird. Nevertheless, it appears to confine its depredations entirely to fishes, and Wilson states that he had never heard of its attaking small birds or any other land animals. In the pursuit of their finny prey, however, these birds exhibit great skill and industry.

They sail about gently over the water, at a considerable height, carefully watching until a fish comes sufficiently close to the surface to be taken by a sudden plunge, when in a moment their wings are closed, and they descend, to use Wilson's words,

"like a perpendicular torrent, plunging into the sea with a loud rushing sound, and with the certainty of a rifle." The bird rises again almost immediately from the water with the fish in his talons, shakes himself, as a dog would do, to get rid of the moisture that hangs about his feathers, and then directs his course towards the shore. When the wind blows from the direction in which the Fish Hawk's nest lies, the tackings adopted by the loaded bird to avoid flying directly in the wind's eye are described as very ingenious. This will not be wondered at when we consider that the fish which this small Eagle sometimes bears to the shore are considerably heavier than himself.

The foot of the Osprey (Fig. 305) is beautifully adapted for the capture of its slippery prey. The tarsus is very stout, and the toes strong and armed with long, acute claws; the upper part of the toes, as in all the other Eagles, is covered by a few scutella, especially towards the apex; but the scales of the sides, and those covering the pads beneath the toes, are all furnished with small central points, many of which are so long as to merit the name of spines, and would of course be of the greatest service in enabling the bird to take a firm hold of the smooth body of a fish. The outer toe, also is capable of being turned back so as to form at least a right angle with the middle toe, and thus the prey can scarcely fail of being firmly grasped.

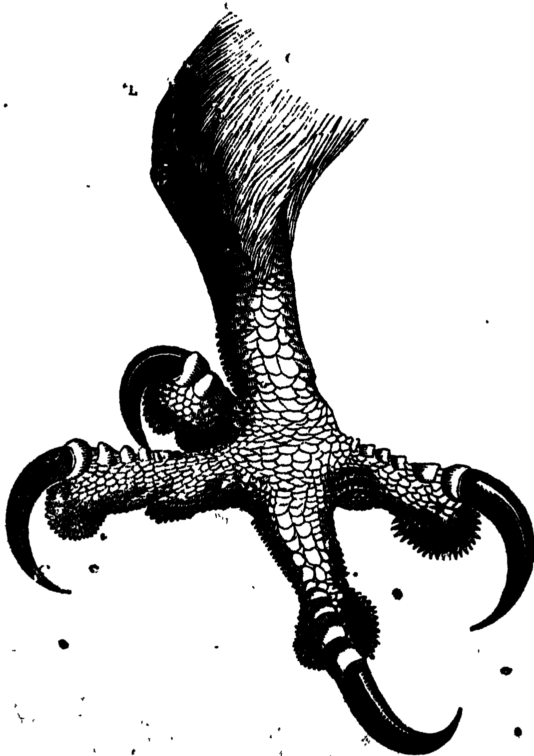


Fig. 305.—Foot of the Osprey (*Pandion Haliaëtus*).

It builds a large nest, generally in a high tree, but sometimes at no great height from the ground; and Mr. Audubon states that he twice saw the nest of this bird on the ground itself. The eggs are three or four in number, and during the process of incubation the female, although she occasionally takes a short flight, is regularly supplied with food by the male.

Two other species of Ospreys are found in the East Indies, and a third in Australia; but they appear to be very similar to the common species in their habits.

The *Haliastur Indus*, or Pondicherry Eagle, called the Brahming Kite by the

European residents in India, feeds to a certain extent on fishes, which it snatches from the surface of the water; but it also preys upon small birds and other animals, including crabs and insects, and will not refuse carrion. It is regarded by the Hindoos as sacred to Vishnu.

Amongst the South American Eagles we may notice the Harpy Eagle (*Harpyia destructor*), which is one of the largest birds in the group. It measures about three feet and a half in length, and its bill and claws are very large and robust, giving it a most formidable appearance, which is considerably enhanced by the singular crest which ornaments the back of the head. Its aspect, however, is by no means so imposing as that of the Golden Eagle. This bird is found in the warm regions of the interior of South America. Several other species of Eagles, belonging to the genus *Morphnus*, are also found on that continent. Africa and Australia likewise possess several species of this sub-family.

The Buzzards, forming the subfamily of the *Buteoninæ*, like the Eagles, have the basal portion of the ridge of the upper mandible nearly straight as far as the extremity of the cere, which covers more of the bill than in the Eagles. The bill is broader at the base than in the other Hawks, and compressed towards the tip, with the sides sloping and but slightly convex, and the lateral margins distinctly festooned. The wings are long, broad, and rounded, with the third and fourth quills usually the longest The legs are short and robust, with the tarsi sometimes naked, and scutellated both in front and behind, sometimes feathered in front half-way and sometimes completely clothed with feathers to the base of the toes. The latter are rather short, and by no means so robust as those of the Eagles.

The Buzzards greatly resemble the Eagles in their general form, but some of them

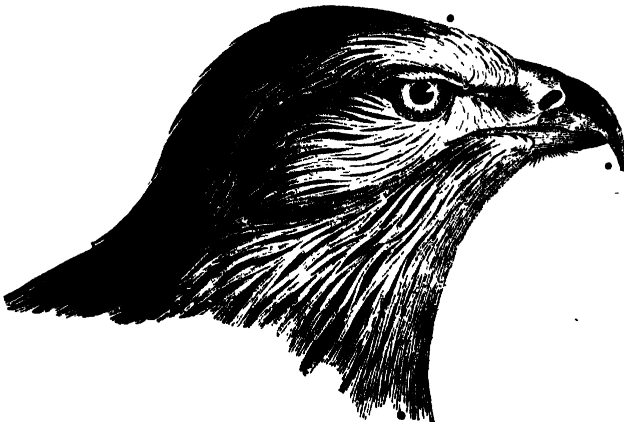


Fig. 306.—Head of the Common Buzzard (*Buteo vulgaris*).

also present affinities to the Hawks and Kites both in structure and habits. They are generally regarded as the least active of the Hawk family, but proceed with considerable rapidity when progressing in a direct course; and often, like the Eagles, ascend to a great height in the air, and then sail in circles with extended wings. When

searching for prey, the Buzzards, like the ordinary short-winged Hawks, fly along at but a small elevation; their food consists principally of small birds and quadrupeds, upon which they pounce on the ground, rarely pursuing birds on the wing. They also feed upon reptiles, insects, and worms.

These birds occur in all parts of the world, but they are most abundant in the Western Hemisphere, especially in South America. Three species are known to occur in Europe, including the Bee Hawk or Honey Buzzard (*Pernis apivorus*), which is placed by some authors amongst the Kites. All these species are found in Britain.

The most abundant is the Common Buzzard (*Buteo vulgaris*, Fig. 306), a bird about twenty inches in length, which is very generally distributed in all parts of the kingdom, and is a permanent resident with us. Its food consists mostly of small birds, mice, shrews, moles, small reptiles, insects, and worms; but it also occasionally attacks Partridges and Grouse. In some places it is known as the Kite or Glead, but is quite distinct from the True Kite. According to the nature of the country in which it dwells, it builds its nest either in trees or on the ledges of rocks; the materials employed in both cases are the same,—namely, sticks, twigs, and heath, with a lining of wool and grass. The eggs are three or four in number.

The Buzzard is generally considered to be an indolent and not very courageous bird, and its character certainly does not present any points of great interest. It is, however, noted for its attention to its young; and in default of the proper objects of their maternal solicitude, Buzzards in captivity have repeatedly hatched and brought up the young of other birds. An instance of this is related in the following words by Mr. Yarrell:—"A few years back," he writes in 1845, "a female Buzzard, kept in the garden of the Chequers Inn, at Uxbridge, showed an inclination to sit by collecting and bending all the loose sticks she could obtain possession of. Her owner, noticing her actions, supplied her with materials; she completed her nest, and sat on two hen's eggs, which she hatched, and afterwards reared the young. Since then she has hatched and brought up a brood of chickens every year. . . . . One summer, in order to save her the fatigue of sitting, some young chickens, just hatched, were put down to her; but she destroyed the whole. . . . . When flesh was given to her, she was very assiduous in tearing and offering it as food to her nurslings, and appeared uneasy if, after taking small portions from her, they turned away to pick up grain."

The second British species, the Rough-legged Buzzard (*B. lagopus*), which is distinguished from the former by its feathered tarsi, is by no means so well known here as the common Buzzard; and, indeed, it is only to be regarded as a winter visitor from the north. It is, however, generally distributed over the continent of Europe, has been found in Africa as far south as the Cape of Good Hope, and also occurs in many parts of the United States. It is a rather larger bird than the common Buzzard, which, however, it closely resembles in its habits and food, although it appears to prey upon animals of rather larger size, such as rabbits and wild ducks. It breeds in the northern regions, and migrates southwards for the winter. Its nest is said to be built in high trees.

The Honey Buzzard (*Pernis apivorus*, Fig. 307), appears to be a rare bird in most parts of Europe, and in this country it is only a summer visitor. It is a rather larger bird than either of the preceding, but is said to live to a great extent upon wasps and their larvæ, which have indeed been found in its stomach, and in search of which it is sometimes seen digging. Its general habits, however, are little known; but it appears to feed only upon the smaller animals, and especially upon insects and cater-

pillars. The *Pernis cristata*, an Indian species, has also been found to have a quantity of greenish matter in the stomach, which could only be regarded as the remains of caterpillars; and other specimens of that species had the stomach partly filled with

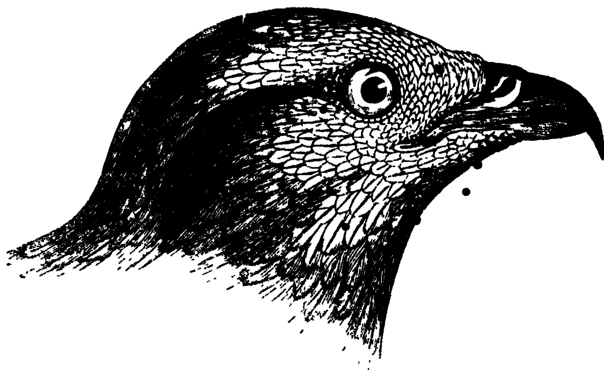


Fig. 307.—Head of the Honey Buzzard (*Pernis apivorus*).

honey, an article of diet for which the European Honey Buzzard is said to have a predilection. The nests of these birds are built in tall trees.

The transition from the Eagles and Buzzards to the Vultures is effected by the *Polyborinæ*, or Caracaras, which possess the carrion-feeding habits of the latter, with the general structure of the birds of the family Falconidæ. These birds have the bill rather elongated, with the basal portion straight, the tip but moderately hooked, and the lateral margins of the upper mandible very slightly festooned. The wings are elongated, with the third, fourth, and fifth quills the longest; the tarsi are long, slender, and covered with scales; the surface of the crop, and often that of part of the head and throat, are naked, or clothed only with a woolly down, giving the bird an exceedingly vulturine character.

With the exception of the Serpent-eaters, the birds of this group are more limited in their distribution than those of any other sub-family of Falconidous birds. They are almost entirely confined to South America, only a single species occurring also in the southern parts of North America, whilst another extends its range into the islands of the Southern Ocean.

The habits of the species have been admirably detailed by Mr. Darwin. The commonest species, which appears to be found in all parts of South America, is the *Polyborus brasiliensis*, which, according to Mr. Darwin, is called the *Carrancha* in the region of La Plata. Together with a smaller species (*Milvago ch'mango*), it constantly frequents the neighbourhood of slaughter-houses, and, when the vultures have taken their fill of the carcase of any animal that dies on the plains, these two Hawks follow them, and pick the bones clean. Of the carrion-eating habits of these birds, Mr. Darwin adds, any one may convince himself "by walking out on one of the desolate plains, and then lying down to sleep. When he awakes, he will see, on each surrounding hillock, one of these birds patiently watching him with an evil eye." Besides carrion, however, the Caracaras feed on worms, mollusca, insects, and frogs—in fact,

on almost anything that serves as food to the smaller Hawks, whilst occasionally five or six Carranchas will unite in chasing the Herons, or other large birds, and they are charged with destroying new-born lambs. They are inactive birds, especially when full-fed, and their flight is slow and heavy. On the ground they run, some of them pretty quickly. Their cry is usually harsh and guttural, and, whilst uttering it, they gradually throw the head backwards, with the bill wide open, until at last the crown of the head almost touches the lower part of the back. The Carrancha, and probably the other species, builds a large rude nest, either in a low cliff or in a bush or tree.

The Chimango (*Milvago chimango*), already mentioned, is said by Mr. Darwin to be "generally the last bird that leaves the skeleton;" and he adds, that it "may often be seen within the ribs of a cow or horse, like a bird in a cage."

All these birds appear to be exceedingly tame and impudent when in search of food; but one species, the *Milvago Australis*, which inhabits the Falkland Islands in great abundance, exhibits a greater degree of boldness than any of the others. When the "Adventure" was at the Falklands in the winter, these birds would attempt to seize the geese which they had shot, and carry them off before their eyes; and on one occasion they dashed down upon a dog that was lying asleep close by one of the party. They would fly on board the ship in search of plunder, and, as they possessed all the thieving propensities of the Corvine birds, they turned out exceedingly disagreeable neighbours. Thus they carried off a large black glazed hat for nearly a mile, and a pair of the heavy balls used in catching cattle were served in the same manner, whilst a small compass, in a red morocco case, appears to have had such attractions for them, that they conveyed it away beyond all hope of recovery. The flesh of these birds, when cooked, is said to be white and good.

From these South American carrion-eaters to the Vultures, forming the family *Vulturidæ*, is an easy step. In these the bill is rather elongated, sometimes strong, sometimes slender, but always straight in its basal portion, and rather suddenly hooked at the tip (Fig. 308). The eyes, as in the preceding family, are placed on the sides of the head, but they are not overshadowed by the strong bony ridge, which gives those organs their peculiarly sunken appearance in the Falconidæ. The wings are long and pointed; the tarsi short, stout, and covered with reticulated scales; and the toes are of moderate size, the hinder one short and rather elevated, and all armed with strong but blunt claws. In the more typical forms of these birds, the head, and frequently the neck also, are quite bare of feathers, or clothed only with a sort of woolly down,—a character which renders the bird almost as disgusting to the eye, as their habits to the imagination. This, however, is a feeling which certainly ought not to be indulged, as some



Fig. 308.—Head of the Egyptian Vulture (*Neophron percnopterus*).

of the ugliest of these birds are of the greatest importance to the natives of the countries which they inhabit, by quickly removing decomposing animal matters and filth of all kinds, which, in those warm climates, would soon become offensive, if not pernicious.

Of the two groups into which we divide the Vultures, that which approaches most closely to the Eagles is the sub-family of the *Gypaetinæ*, or Bearded Vultures, in which the head and neck are entirely clothed with feathers, and the cere of the upper mandible is hidden by projecting bristles. This group only includes a single species—



Fig. 309.—Bearded Vulture (*Gypaëtus barbatus*).

the Griffon, or Bearded Vulture (*Gypaëtus barbatus*, Fig. 309),—the largest of European birds. This large and powerful species measures about four feet and a half in length, and its wings extend to the enormous width of nine or ten feet. The colour of the upper parts in old birds is grayish or blackish brown, with the tips of the shafts white; the lower parts are orange yellow, and the head and neck whitish. It is found, but not abundantly, in various parts of Europe, Asia, and Africa, apparently principally to the north of the line. In Europe it occurs as far north as Germany.

Its habitation is always amongst high mountains, and it builds its nest in the most inaccessible situations, so that its construction is still unknown. In its bold and predatory habits it resembles the Eagles, and, unlike the filthy birds which form the greater part of the family, it will refuse putrescent flesh, unless most sharply pressed by hunger. Its food consists of birds and young Mammalia. In Europe it destroys lambs, kids, and young chamois; indeed, its German-Swiss name of *Lämmergeyer* refers to its partiality for lambs. It is also recorded to have occasionally carried off children. Several instances of this kind are said to have occurred in Switzerland; and Bishop Heber heard that the same thing had taken place in India. Large animals the Bearded Vulture is said to pursue until he drives them over some precipice, when he can descend and feed upon them at his leisure.

The second sub-family includes the true Vultures, or *Vulturinæ*, distinguished by having the head, and usually more or less of the neck, either naked or covered with down. These birds are of moderate or large size; they occur in both hemispheres, but are principally confined to the warmer climates, only two or three species extending into the temperate regions. Their habits are disgusting in the extreme to our ideas, as they appear to have an especial predilection for carrion, by the removal of which, and other nuisances, they certainly confer the greatest benefits on the inhabitants of

hot climates, by whom they are generally regarded with favour. When attracted by the carcase of some large animal, the Vultures often flock together, often from considerable distances. The mode in which they acquire their knowledge of the presence of their favourite food, appears to be still rather doubtful; some naturalists maintaining that they are guided by the sense of smell, whilst others insist that it is to sight alone that they are indebted for their information. Some years ago this was the subject of acrimonious disputes amongst some ornithologists; but the most generally received opinion at present is, that the Vultures discover their prey by sight. Some of them also prey upon living animals, in the same manner as the other Raptorial birds.

They fly pretty well, often soaring to a great height, and sailing in large circles. Their nests are made on the ground or amongst rocks, and sometimes also in trees; they appear to be even ruder than those of the Falconidæ. Their eggs are usually from two to four in number.

Of the species belonging to the Old World, three are commonly found in the South of Europe. These are the *Vultur monachus*, or Arabian Vulture; the *Gyps fulvus*, or Tawny Vulture (Fig. 310); and the *Neophron percnopterus*, or Egyptian Vulture (Fig. 308), frequently called Pharaoh's Chicken. These birds occasionally visit central Europe, and specimens of the last two species have been killed in England.



Fig. 310.—The Tawny Vulture (*Gyps fulvus*).

Amongst the American species we may notice the famous Condor (*Sarcorhamphus gryphus*), about which so many wonderful stories were told by the older writers. The accounts given of its size and powers seemed almost to justify the descriptions of the fabulous *Roc* in the tales of Arabian voyagers. It is, however, only a little larger than the Bearded Vulture of Europe, and appears to be inferior to that powerful bird in the extent of its wings and the strength of its talons. In its habits it is intermediate between the Bearded Vulture and the ordinary Vultures; it feeds principally on the dead carcases of animals, but will occasionally make a combined attack even upon large quadrupeds. It inhabits the most inaccessible parts of the Andes, usually at a height of from 10,000 to 15,000 feet, where it breeds and brings up its young, laying its two large white eggs upon the bare rock. In its flight it rises to immense heights in the air. The highest flight observed is said to be 21,000 feet; but it is probable that the bird may attain a still greater elevation. It usually sails in majestic circles, with the wings fully expanded and motionless; and Mr. Darwin states that he once watched some for half an hour without perceiving the slightest flapping of the wings. Changes of direction appeared to be produced by the vigorous action of the head and tail.

Another species of the genus *Sarcorhamphus* (so called from the fleshy wattles about the head and base of the bill), is the King Vulture (*S. papa*), which is not uncommon in Brazil and Guiana. This bird is remarkable for the brilliant colours of the naked skin of the head and neck, and also for the apparent respect which is paid to him by the common Brazilian Vultures. It is said that if a King Vulture approaches a carcase

about which a number of the common species have already collected, the latter will meekly give way, and stand looking on until the new-comer has gorged himself. It is from this that he derives his title of the King of the Vultures. This bird is said to make its nest in hollow trees.

The common American Vulture is the Turkey Vulture (*Cathartes aura*), or Turkey Buzzard, as it is sometimes called. It is found abundantly in almost all parts of America, but more especially in the tropical regions. In the colder parts of the continent it is migratory. Two or three other nearly allied species are found in different parts of America.

With the Vultures we conclude the series of birds, and now proceed to the last and highest class of the Animal Kingdom, that of the MAMMALIA, which includes our own species amongst its members.

## CLASS V.—MAMMALIA.

**General Characters.**—The great majority of the animals included in the class of Mammalia, are those commonly known as *Quadrupeds*, that is to say animals which have four feet adopted for progression on a solid surface. We cannot however say that the old term Quadruped is synonymous with Mammal, as it is just as applicable to many Reptiles as to the true Mammalia, whilst some important members of the latter class cannot be denominated Quadrupeds. The leading character upon which the separation of this class from the rest of the Vertebrata is founded, consists in their truly viviparous reproduction, and the peculiar provision for the sustenance of the young for some time after their birth, to which we shall have occasion to refer hereafter.

The form of the body in the Mammalia varies very considerably, but we can always distinguish, at least in the skeleton, a division of the animal into three regions,—the head, neck, and trunk. In by far the greater part of the class, these three divisions are clearly perceptible in the living subject, and it is only in the fish-like Cetacea that the neck becomes as it were, amalgamated with the trunk. The limbs are always four in number, but they undergo so many modifications in form, that we must leave their consideration until we come to treat of the skeleton. The jaws instead of being covered, as in the birds, with a horny bill, are concealed by fleshy lips, and armed with bony teeth. The clothing of the body also is different from that of any of the other vertebrated animals; it consists of *hair*, and although it certainly undergoes considerable modifications in different members of the group, yet few are entirely destitute of true hairs.

The bones of the Mammalia are distinguished from those of birds by the absence of the air cells, which in those animals give to the skeleton the lightness necessary for their aerial existence; most of the bones in the Mammalian skeleton are solid, and the cavities of those which are not so, are filled with a peculiar oily matter, called marrow. Some of the bones of the head are, however, usually furnished with air cells, but these do not communicate, as in birds, with the lungs, but receive their supplies of air from the nose and ear. These air cavities are known as sinuses, and those of the frontal bone acquire a large size in many of the Ruminant quadrupeds (such as the Ox, Sheep &c.), whilst it is to the great extent of the air cells in the cranial bones that the Elephant is indebted for the large size of his head, which is such an important element in producing the striking sagacity of his appearance.

The general structure of the skeleton is as follows. The skull is of variable form,

but the bones both of the cranium and face are immoveably connected with each other, a character which does not occur in any of the preceding classes. The cavity of the

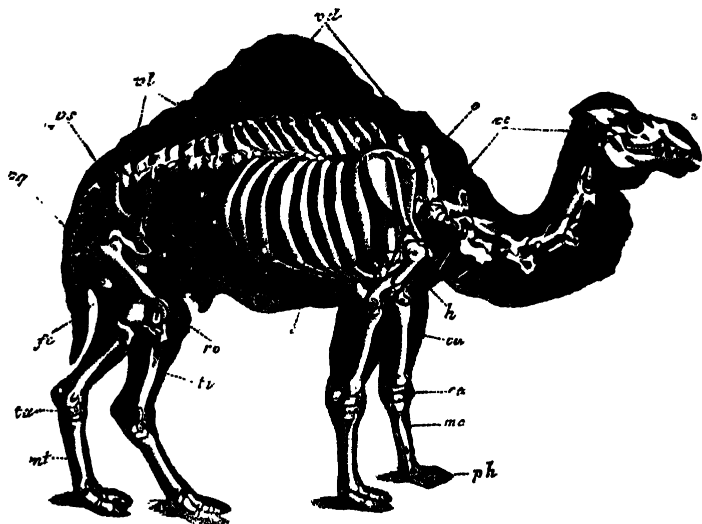



**Fig. 311.**—Skeleton of the Camel. *vc*, cervical vertebræ; *vd*, dorsal vertebræ; *vl*, lumbar vertebræ; *vs*, sacral vertebræ; *vq*, caudal vertebræ; *c*, ribs; *o*, scapula; *h*, humerus; *cu*, arm-bone; *ca*, carpus; *mc*, metacarpus; *ph*, phalanges; *fc*, femur; *ro*, patella; *ti*, tibia; *ta*, tarsus; *mt*, metatarsus.

cranium is also larger than in the reptiles and birds. The base of the skull is formed by the *occipital bone*, which here forms a single bone perforated by the great foramen through which the base of the spinal-cord passes. It bears close to this aperture a pair of prominent condyles (or articulating tubercles) by which the skull is articulated to the first vertebra of the neck. The position of the occipital bone in relation to the mass of the skull varies greatly, and it is upon this that the direction of the head, as compared with that of the axis of the body, entirely depends. Thus in man the occipital bone occupies the lower part of the skull, so that the condyles are brought nearly under its centre; hence the head is kept in equilibrium, and its direction becomes perpendicular to that of the axis of the body. As we recede from man, however, the occipital bone gradually shifts its position backwards until in the lower Mammalia, it actually forms the posterior portion of the skull; and, in proportion as it approaches this position, the

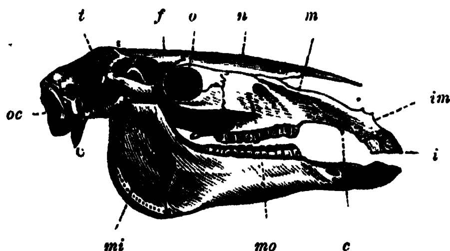



**Fig. 312.**—Skull of the Horse; *oc*, occipital bone; *t*, temporal; *f*, frontal; *n*, nasal; *m*, superior maxillary; *im*, intermaxillary; *mi*, inferior maxillary; *o*, orbit; *i*, incisor teeth; *c*, canines; *mo*, molars.

direction of the head becomes nearer and nearer to that of the general axis. In front of the occipital bone the floor of the cranial cavity is formed by the *sphenoid bone*, which although usually free, is not unfrequently amalgamated posteriorly with the occipital. The wings of the sphenoid bone form part of the sides of the cranium, which however are formed principally by the *temporal bones*, which in adult animals form a single plate on each side of the head. In the young state each of the temporal bones is composed of four distinct pieces, which are usually recognizable in the adult; these are the petrous portion of the temporal bone (*os petrosum*) which forms part of the base of the skull, and encloses the labyrinth of the ear; the mastoid process, which often contains cavities connected with the ear; the tympanic bone, surrounding the tympanum, which although often small, is frequently developed into a large bladder-like protuberance beneath the skull; and lastly the squamous portion of the temporal bone, which forms a larger or smaller part of the side walls of the skull. From the temporal bone, immediately in front of the ear, arises a process which runs forward to meet a similar process of the malar bone; these form the *zygomatic arch*. The posterior portion of the roof of the skull is formed by the two *parietal bones*, and the anterior portion by the *frontal bones:* the latter however in some Mammalia, as for instance in man, unite to form a single plate. The horns of the Ruminants are supported upon processes of the frontal bones. In front of the cranial cavity, is the *ethmoid bone*, through which the olfactory nerves pass, and which also sometimes assists in the formation of the inner walls of the orbits.

The facial bones, consist of a pair of *nasal bones* which cover the cavity of the nose and are usually of considerable size; a pair of *maxillary bones* forming the sides of the upper jaw; a pair of *intermaxillary bones*, placed immediately below the nose and bearing the incisor teeth, which however are sometimes, as in man, amalgamated with the maxillaries; and a pair of *malar bones* which form the outer and inferior margin of the orbits, and give rise to the process which completes the zygomatic arch. The orbits are completed by the *lacrymal bones*.

The roof of the mouth is composed of the horizontal process of the maxillary and intermaxillary bones, and behind these the true *palatine bones*. The *pterygoid bones* which in the birds are quite distinct are in the Mammalia amalgamated with the sphenoid; besides these the nose includes the *vomer* and a pair of *turbinated bones*.

The lower jaw never consists of more than two pieces, thus forming a striking contrast to the Reptiles, in which each half of this organ is always of a compound nature. When the two halves of the lower jaw form separate bones, they are united in front by cartilage, but in the majority of the Mammalia they are firmly attatched to each other either by a suture, or by the complete amalgamation of the two halves, which then form a single piece. The lower jaw is articulated to the temporal bone, close to the base of the zygomatic process. At this point we find a more or less distinct cavity for the reception of the convex articulating surface of the lower jaw, and both these surfaces vary greatly in size and form according to the particular motion required by the lower jaw. Thus, to take two extreme instances, in the carnivorous cats in which the motion of the jaw is directly up and down, the condyle is elongated, somewhat cylindrical and placed transversly upon the jaw; it fits accurately into a corresponding transverse groove at the base of the zygomatic process, thus forming a complete hinge joint. In the herbivorous ruminants on the contrary, in which the jaw requires a sort of rotatory motion in order to the proper comminution of the food, the condyle is small and rounded and the surface to which it articulates is but slightly impressed. The portion

of the jaw upon which the condyle is situated is more or less turned upwards, forming what is called the ascending *ramus* of the jaw, and this is usually continued above the condyle in the form of a flat process, which passes within the zygomatic arch, and gives attachment to a portion of the muscles of the jaw. This structure of the lower jaw is peculiar to the Mammalia.

The teeth with which the jaws are armed exhibit a great variety not only in their arrangement but also in their structure. They are all, however sunk into sockets of the jaw, an arrangement which only occurs in the crocodiles amongst the Reptiles. The most common form is that which occurs in the human subject, in which the teeth exhibit a distinct crown, or protruded portion, covered with a layer of very hard enamel, whilst the root, or portion immersed in the socket, is destitute of this coating. The outer coating of enamel in these teeth is often curiously folded, so as to give an irregu'ar outline to the internal ivory; this becomes perceptible in a section of the tooth, or when the upper surface is worn away by use. In some cases also, besides the external coating of enamel, small dots or rings of that substance are to be seen scattered in the ivory. In many herbivorous quadrupeds we meet with another form of teeth, peculiarly adapted to the grinding of their food. This process requires an irregular surface, and accordingly the teeth are composed of intermixed layers of enamel, dentine (or ivory) and a third substance, called the *cementum* or *crusta petrosa*. The latter is softer than either of the others, so that substances of three different degrees of hardness are always exposed at the surface of the tooth, and as these necessarily wear away unequally, the requisite roughness is preserved by the mere act of mastication.

The teeth are divided into three groups in accordance with their position and consequent functions. The first of these are the *incisors*, or cutting teeth, which occupy the intermaxillary bones in the upper jaw, and the corresponding portion of the lower jaw. These vary considerably in their form, but are usually of a flattened shape, with a transverse cutting edge, and they are employed in biting off those portions of the food which are afterwards to be comminuted by the teeth appointed for that purpose. These teeth are sometimes absent in one or both jaws; when present their number varies from two to ten. In the Rodentia they are of very peculiar construction, which will be described when we treat of that order, and in some other Mammalia they attain an enormous development, as in the Elephant, the Hippopotamus, and the Narwhal.

On each side of the incisors, but frequently separated from them by a considerable interval we find a single tooth in each jaw, which is usually of a more or less conical figure. These teeth are called the *canines* from their great prominence in the Dog, a character possessed also by all carnivorous animals, to which these teeth are of great use in biting and tearing their prey. The canines are entirely deficient in the Rodentia and in nearly all the Ruminants; they are small in most herbivorous animals, but attain a large size in the Hippopotamus, and in the upper jaw of the Walrus.

The third group of teeth consists of the *molars* or grinding-teeth, situated in the sides of the jaws, and extending to the back of the mouth; they serve for the comminution of the food, and undergo many modifications according to the nature of the nourishment usually consumed by the animal. Thus in the carnivorous Mammalia these teeth have strongly compressed crowns, furnished with a sharp cutting edge, and the teeth of the two jaws come together like the blades of a pair of scissors, an arrangement admirably adapted for the division of flesh; in the insect-eating species, the molars present a double row of sharp points, with deep cavities between them, a structure which enables these creatures to crush the hard bodies of

beetles with facility; those species which feed upon a mixed diet of flesh and vegtables, have the molars furnished with crowns of a quadrangular form, the surface of which is formed by several small tubercles, whilst the truly herbivorous Mammalia have the harder and softer parts of the teeth more or less intermixed, so that as the crown of the teeth wears away an efficient grinding surface is always preserved. The molars are always inserted in the jaw by two or more roots, and as this structure is peculiar to the Mammalia, it furnishes the Geologist with an important character in the determination of Mammalian remains; but in many of these animals the most anterior of these teeth exhibit a different structure from the posterior ones, and are distinguished as *false molars* or *præmolars*; these are intermediate in form between the true molars and the canines, and sometimes like the latter have only a single root. The molars are present in all the Mammalia, with but very few exceptions (the *Monotremata*, a few *Edentata* and the true Whale).

The vertebral column of the Mammalia is distinctly divisible into five regions, the vertebræ composing which are distinguished as the *cervical*, *dorsal*, *lumbar*, *sacral*, and *caudal* vertebræ. The only exceptions to this universal rule are afforded by the Cetacea, in which, as the hinder extremities are not developed, the sacrum does not exist, and the lumbar vertebræ pass at once into the caudal. In some Mammalia—as, for instance, in our own species—the caudal vertebræ are reduced to a very rudimentary state, but their existence is still recognizable.

Of these five regions, the only one in which the number of vertebræ is constant is that forming the neck; the cervical vertebræ are invariably seven in number,—in the long slender neck of the Giraffe, as in the short thick support of the bulky head of the Elephant. The only apparent exception to this rule is met with in the Sloths in which the number of vertebræ in the neck is eight or nine. In these cases, however, the additional vertebræ really belong to the dorsal series, as they are furnished with rudimentary ribs. They may, therefore, be regarded as dorsal vertebræ, in which the ribs do not reach the sternum; and the object of this modification, as pointed out by Professor Bell, is no doubt to give additional mobility to the neck. In the Cetacea, whose short necks do not require any flexibility, the cervical vertebræ are firmly anchylosed together, forming a single bone.

The dorsal vertebræ are distinguished from the cervical by the possession of spinous processes for the attachment of ligaments, which are of very large size in the species with long necks or heavy heads; they also exhibit surfaces for the articulation of the ribs. The number of the dorsal vertebræ and ribs is very variable, some species having only eleven, whilst others have as many as twenty. The ribs are moveably articulated to the vertebræ, and at the opposite extremity they are usually connected by a cartilage with the sternum, and this rarely becomes ossified as in the birds. A greater or less number of the hinder ribs are not immediately connected with the sternum, but their extremities are attached to a ligament which runs from the posterior extremity of the sternum to the last rib. These are called *false*, or *floating ribs*. This arrangement gives great mobility to the bony case of the thoracic cavity; and it is mainly by the action of the costal muscles in raising and depressing the ribs, that the size of that cavity is altered so as to produce the alternate inspiration and expiration of air. The sternum is composed of several bones placed one behind the other in the centre of the breast; these are distinct in many of the Mammalia, but in others they are amalgamated into a single piece.

The lumbar vertebræ differ from the dorsal in their much greater strength and in

the absence of ribs, which are here replaced by very long transverse processes. They are also variable in number. The sacrum is usually formed of three or four vertebræ; it is wanting in the Cetacea. This is followed by the caudal vertebræ, which vary in number according to the length of the tail, and consequently to a greater extent than those of any other region of the body. The number of vertebræ which enter into the composition of the *os coccygis*, the representative of the tail in the human body, is only four, whilst some of the long-tailed Mammalia have upwards of forty vertebræ in this part of the body. The caudal vertebræ gradually diminish in size and completeness as they approach the end of the tail, where they usually consist only of a simple cylindrical body, without any traces of arches or processes.

In no group of corresponding extent is the construction of the limbs so various as in the Mammalia; no other affords, within the same compass, so many instances of the modification of the same type to suit different requirements. Thus we have the swimming paddle of the Whale, the walking feet of the Horse or Ox, the formidable paw of the Lion or Tiger, the wing of the Bat, and, lastly, the wonderful hand of Man, all formed from the same elements, merely modified in each case to adapt each particular animal for the sphere of life in which it was intended to act. It will be unnecessary to dwell any longer in this place upon these beautiful adaptations, as we shall have occasion to refer to these and many others when treating of the different groups into which the class is divided; and it will be sufficient for our present purpose to give the reader a general idea of the construction of the limbs.

The anterior limb is attached to the trunk by a broad shoulder-blade or *scapula*, which is applied to the surface of the ribs, and is usually kept in its position by a *clavicle*, which springs from the anterior extremity of the sternum, and rests with its upper extremity against a process of the free end of the scapula. The clavicle is wanting in many Mammalia. In the *Ornithorhynchus*, the two clavicles are united to a central piece, forming a single T-shaped bone, which reminds one of the furcula of a bird, and in this animal also the coracoid bone is fully developed, and assists in the formation of the scapular arch, whilst in the rest of the class it is reduced to a very small size, and amalgamated with the scapula. The *humerus* is articulated to the lower part of the scapula by a ball and socket joint, and at its opposite extremity bears a transverse convex articulating surface for the reception of the bones of the forearm (*radius* and *ulna*), with which it forms a sort of hinge-joint. The radius and ulna are distinct and moveable in man and some other animals, and separate in the middle and anchylosed at the extremities in others; whilst, in the hoofed animals generally, they are represented by a single cylindrical bone. They are followed by a variable number of small bones (the *carpal bones*), forming the wrist joint, and these in their turn give attachment to the *metacarpal banes*, the five parallel bones which constitute the palm of the human hand, but which in the other members of the class are gradually reduced until in most of the hoofed quadrupeds they are represented like the radius and ulna, by a single cylindrical bone. These are followed by the *phalanges*, or bones of the fingers, each of which is usually composed of three joints, but the number of fingers varies from five to one.

The structure of the posterior extremities is perhaps rather more uniform than that of the anterior pair. Their supporting arch is the *pelvis*, composed of three bones on each side—the *ilium*, the *ischium*, and the *os pubis*. The ilia are firmly attached to the sacrum, and the space between them, at the lower or anterior part of the pelvis, is occupied by the two *ossa pubis*, which always meet and frequently unite by a suture. The ischia form the hinder or lower part of each side of the pelvis; they are the prominent

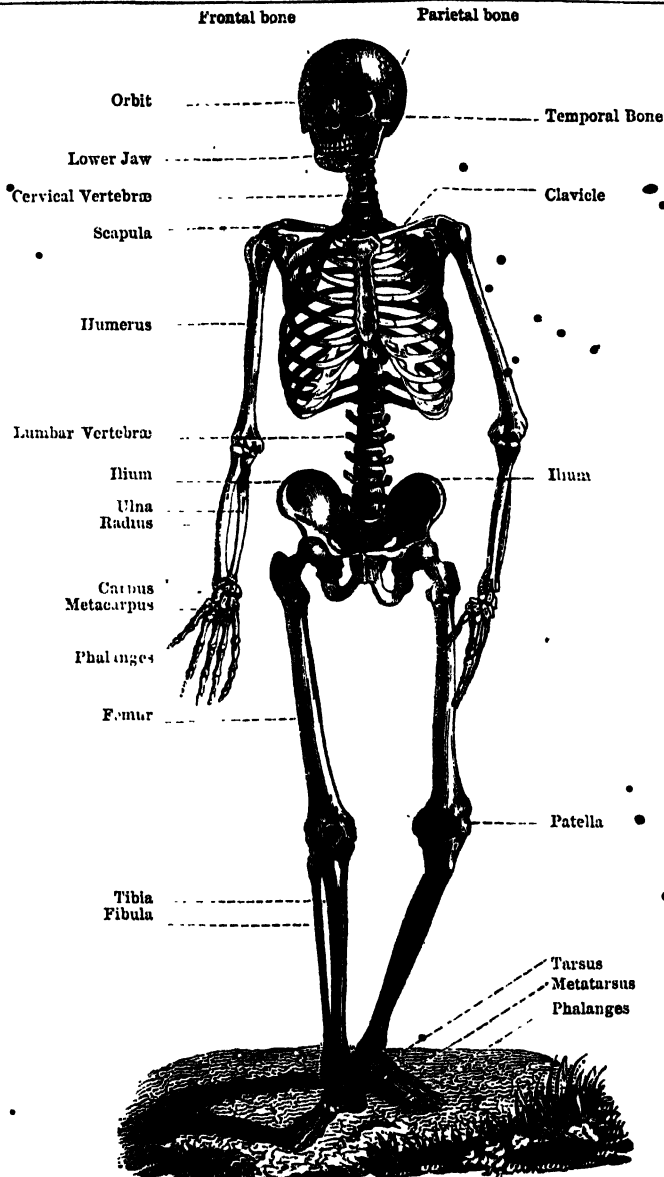



Fig. 313.—Skeleton of Man.

bones upon which we sit. The *femur*, or thigh-bone, the first moveable bone of the hind limb, is attached to the pelvis by a large ball and socket joint, and the ball at the head of the femur is always set at a greater or less angle to the axis of the bone. This is especially observable in the human skeleton (Fig. 313). The *tibia* and *fibula*, forming the shank, are articulated to the extremity of the femur by a joint resembling that at the elbow in the fore limb, but turned in the contrary direction; and in front of the joint is a small bone called the *patella*, or knee-cap. Below these are the *tarsal bones*, corresponding with the carpals in the anterior extremity, and these are followed in like manner by the *metatarsal bones* and *phalanges*. The tibia and fibula, and the metatarsal bones exhibit the same variety in their number and arrangement as the radius and ulna, and the metacarpal bones in the fore limb; and the phalanges in both pairs of extremities are liable to the same modifications. The general structure of the skeleton, and the modifications to which it is subject, will be readily understood by a comparison of the cut of the human skeleton (Fig. 313) with that of the camel (Fig. 311), as these may be taken to represent nearly the two extremes of the ordinary Mammalian skeleton.

The skin in the Mammalia, as in the other vertebrate animals, consists of a *cutis*, or true skin, and of a horny *cuticle*, or *epidermis*. The former is often of great thickness, but the cuticle is a thin layer composed of horny cells, which are continually renewed from the materials forming the subjacent layer, commonly known as the *rete mucosum*, in which are deposited the proper colouring matters of the skin. In some parts of the body, however, especially where delicate organs are to be protected from pressure, the cuticle becomes greatly thickened; instances of this may be seen in the callosities which make such a disagreeable figure on the buttocks of many monkeys, and the balls of the feet of many quadrupeds. In many cases, also, the cuticle becomes converted into distinct scales, as, for example, on the tails of rats and mice.

The ordinary clothing of the skin consists of hairs, which are small horny cylinders, produced from pulps placed at the bottom of small capsules in the skin. These capsules consist of small indentations of the cutis, which are lined with cuticle, and the pulps are abundantly supplied with vessels which bring the nourishment required for the growth of the hair. The interior of the cylinder is usually occupied by a coloured oily matter, and its external surface, although frequently smooth, is often formed apparently of distinct scales. The differences of thickness and texture in these organs is very great, so much so that different names are given to the leading varieties, even in common language—such as wool, true hairs, and bristles. What is called *fur*, consists of the two former kinds of hair—wool and true hair—the soft woolly hair forming a warm inner coat, whilst the longer true hairs, upon which the beauty of the fur depends, serve to protect the inner layer from the weather. The hair in some animals continues constantly growing, but in others it is shed from time to time, and replaced by a fresh coat.

Besides the ordinary forms of hairs, we meet with many dermal appendages in the Mammalia, which, although apparently very different, are really of the same nature. Amongst these are the quills of the Porcupine, and the prickles of the Hedgehog, which, notwithstanding their much greater thickness, are produced in the same way as ordinary hairs, of which, in fact, they appear to be an agglomeration. A still more remarkable form is seen in the scales of the *Manis*, which are found to be composed of parallel horny tubes exactly analogous to hairs. Besides these, the claws, nails, and hoofs of the Mammalia, the horns on the nose of the *Rhinoceros*, and the horns of the

hollow-horned Ruminants (such as the ox and sheep) are all composed of a substance, the structure of which shows its origin to be analogous to that of hair.

Besides the capsules of the hairs, the skin in the Mammalia contain an immense number of minute glandular organs, some of which are instrumental in producing the constant evaporation of moisture from the skin, which we call *perspiration*, whilst others, known as *sebaceous follicles*, secrete a fatty matter, which lubricates the skin, and keeps it soft and flexible. Of the latter, many discharge themselves by ducts into the capsules at the base of the hairs, the surface of which is thus slightly greased Glands of a similar nature, but larger size, inserted in the skin of particular parts of many animals, produce peculiar secretions of an odoriferous nature, and it is to this that some species are indebted for the disagreeable smell which they emit when alarmed.

In the structure of the digestive organs the Mammalia present a tolerable degree of uniformity, although the construction of the stomach in particular groups undergoes some remarkable modifications, which will be described hereafter. In nearly all the members of this class the mouth is surrounded by moveable fleshy lips and cheeks, which, in some cases, are capable of great extension; the lips then form delicate prehensile organs, and the cheeks form pouches, in which food may be conveniently stowed away. The tongue presents a good deal of variety in its form and degree of mobility, but it is always of a fleshy texture. In the Whales, it is immoveably fixed to the bottom of the mouth; but in most of the Mammalia it is free, and composed of the same muscles as in the human subject; in some cases it is capable of considerable extension, and is sometimes used as a prehensile organ. The most remarkable form is that presented by the Ant-eater and *Echidna*, in which, by a peculiar arrangement of the muscles, the tongue is capable of being protruded to a great distance from the mouth, in search of the insect food on which these creatures subsist. The surface of the tongue is usually covered with small elevations or papillæ, which, in some carnivorous quadrupeds, give place to recurved horny hooks; these convert the tongue into a formidable rasp, which is employed by the creatures in scraping the last remnants of flesh off the bones of their prey.

At the back of the mouth is an organ which is peculiar to this class, it is a sort of fleshy valve, called the *velum palati*, the office of which is to protect the posterior opening of the nose. Beyond this is the *pharynx*, into which not only the mouth but also the nasal cavities and the trachea open. The opening of the latter is closed by a cartilaginous valve (the *epiglottis*), which prevents the passage of the food into the trachea during deglutition. From the pharynx the *œsophagus* leads straight down into the stomach, passing close in front of the vertebral column in the form of a uniform muscular tube. The *stomach* presents a considerable variety of form; it is usually a simple cavity, but in some species it is divided into several compartments by constrictions; whilst in the Ruminants, it becomes a compound organ, consisting of four separate stomachs, the construction and uses of which will be described in treating of that order of animals. The remainder of the intestinal canal consists of the small and large intestines. The former commence at the pyloric extremity of the stomach, and present nothing remarkable in their structure. They are shorter in the carnivorous than in the herbivorous species. They usually enter the large intestine at some little distance from its commencement, leaving a blind sac of greater or less extent above the point of junction; this is called the *cæcum*, and in man and a few other Mammalia, it is furnished with a narrow appendage, called the *vermiform* appendage. The large in-

testine, or *colon*, is continuous with the *rectum*, which leads directly to the anal opening, and exhibits no particular character, except in the Monotremata, where it forms a *cloaca* similar to that of birds.

The *liver* is of considerable size, frequently divided into several lobes, and almost always provided with a gall bladder. The *pancreas* and the *spleen* are always present, but present no remarkable peculiarities. Besides these abdominal glandular organs, the mouth is supplied with moisture from three pairs of *salivary glands*, which, however, are wanting in the Cetacea.

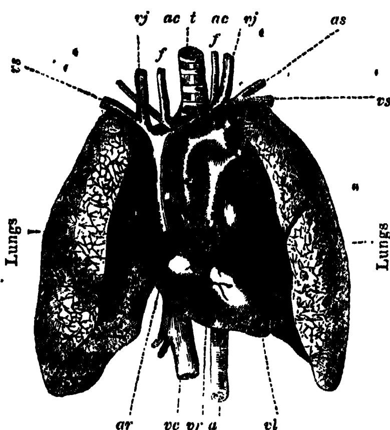



Fig. 314.—Lungs, Heart, and principal vessels of Man. *ar*, right auricle; *vr*, right ventricle; *vl*, left ventricle; *a*, aorta; *vc*, vena cava; *ac*, carotid arteries; *vj*, jugular veins; *as*, subclavian artery; *vs*, subclavian veins; *t*, trachea.

The organs of circulation and respiration are somewhat similar in structure and function to those of birds, that is to say, the heart consists of four cavities, and the circulation is complete and double, the whole of the blood passing through the lungs on its return to the heart before it is again driven into the arteries of the body; and the temperature of the blood is always considerably higher than that of the surrounding medium. The lungs, however, present a considerable deviation from the type of the birds; they are almost always in pairs, and hang freely in the thoracic cavity suspended by the straight trachea, enclosed within a serous sac, which completely prevents their contact with the ribs or any of the internal organs. They are consequently completely closed, and do not offer those apertures of communication with air cells in the body which we have seen to be characteristic of the lungs of birds. The texture of the lung itself is also more uniformly spongy than in either the birds or reptiles. There is another distinction between the Mammalia and birds, in the complete separation of the thoracic and abdominal cavities by means of a muscular partition, called the *diaphragm*, which divides the general cavity of the body into two separate compartments.

The *kidneys*, which are usually of the same form as in the ordinary domestic animals, are always situated close to the lumbar vertebræ, one on each side of the descending aorta, from which they receive their supply of blood. They are composed of numerous minute and bifurcating tubes, radiating in every direction round three sides of a cavity, called the *pelvis*, which receives their secretion, and passes it into the canal (the *ureter*) which rises from the fourth side. In the adult state the kidneys usually present a nearly even surface, but in the embryo they exhibit a lobulated structure, showing that the organ is a compound gland, and in some cases this form is permanent, as, for instance, in the Cetacea, whose kidneys have been compared to a bunch of grapes. The ureters convey the urine to the *bladder*, which is universally present in the Mammalia, and from this it is discharged through a canal called the *urethra*, the external orifice of which is common to it and the generative apparatus, and is not connected with that of the intestine, except in the singular order of the Monotremata.

The nervous system in the Mammalia is remarkable for the large size of the brain, and especially of its hemispheres, in comparison with the rest of the nervous system. The surface of the cerebral hemispheres exhibits a more or less convoluted appearance; and a French naturalist, M. Gratiolet, has put forward the opinion, that the number of convolutions are indicative, to a certain extent, of the intelligence of the animals. The hemispheres are united beneath by a fibrous band (the *corpus callosum*), which, however, is wanting in the marsupials and Monotremata. The olfactory ganglia are reduced to a comparatively small size, as are also the optic lobes, which are usually represented by four small tubercles, called the *tubercula quadrigemina*. The cerebellum is sometimes situated quite at the back of the cerebral hemispheres, so as to be visible from above; but in the higher Mammalia the latter gradually cover it, until in man it is almost completely concealed. In some cases, also, the structure of the cerebellum agrees with that of birds, the centre of the organ being of large size, whilst the lateral portions are small; but this structure is gradually lost, until in man the cerebellum is almost entirely composed of the lateral lobes.

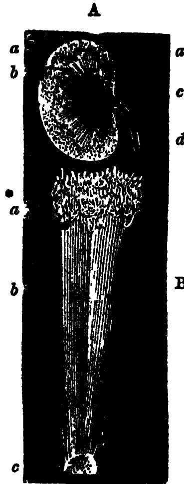


Fig. 315.—Structure of the Human Kidney.
A, vertical section of the kidney; *a*, cortical substance; *b*, tubular substance; *c*, calyx and pelvis; *d*, the ureter.
B, portion of the gland enlarged; *a*, extremity of the uriniferous tubes; *b*, straight portion; *c*, their termination in the calyx.

The organs of the senses are all present in a state of great perfection in the Mammalia. The nasal cavity is divided into two compartments by a perpendicular septum, partly composed of bone and partly of cartilage. The nasal plates of the ethmoid bone and the convolutions of the turbinated bones form a series of complicated passages, through which the air passes on its way to the lungs, and these are coated throughout with a delicate membrane, which is kept constantly moist by a peculiar secretion, and is abundantly supplied with minute branches of the olfactory nerves. In those quadrupeds which are pre-eminent for the perfection of their sense of smell, the number of convolutions, and, consequently, the extent of surface constantly exposed to the air, is most extraordinary. The branches of the olfactory nerves pass through the numerous openings in the ethmoid bone, which receives its name from the sieve-like appearance which it presents in consequence. The nasal passages open posteriorly into the pharynx, and the anterior openings, or nostrils, instead of being mere perforations in a horny covering, like those of birds and reptiles, are pierced in the midst of moveable cartilages, which, by the action of peculiar muscles, are generally endowed with a greater or less amount of motion. In some Mammalia the nose is greatly prolonged, and exceedingly moveable; as, for instance, in the Elephant. In the Cetacea, the nasal passages serve both for the passage of air and water, but they are quite destitute of nerves, and these animals do not appear to have any sense of smell. The peculiar modifications of the nose in these Mammalia will be described hereafter.

The structure of the eye throughout this class is exactly the same as in the human subject. In the aquatic species, the lens becomes spherical, as in the fishes, and in many the choroid coat is covered with a brilliant layer of pigment, which shines brightly under particular conditions. The pupil is usually round, but in many

animals it contracts into a slender fissure when exposed to a strong light; the direction of this fissure is transverse in the Ruminants, and perpendicular in the Cats. The ball of the eye is usually globular, and its movements are effected by the agency of six or seven muscles.

The auditory apparatus, the earliest of the organs of sense to make its appearance, attains its highest perfection in the Mammalia. The internal ear is entirely imbedded in the petrous portion of the temporal bone, and is remarkable for the great development of the cochlea, which sometimes exhibits as many as five circumvolutions. In the Monotremata, however, which in many particulars of their construction appear to approach the reptiles and birds, the cochlea is of a much more simple form. The tympanic cavity is very large, and usually communicates with cells hollowed out in the neighbouring bones; it is also connected with the mouth by the Eustachian tube. Instead of the single long ossicle, which in the birds and reptiles forms the communication between the tympanum and the labyrinth, we find a series of four of these minute bones, of different forms. The Mammalia are also distinguished by the presence of a true external ear, which is generally in the form of a funnel, composed of cartilage and clothed with skin and hair, the office of which is evidently to concentrate sound, and convey it directly to the drum of the ear. This is moved by an apparatus of muscles, and in many quadrupeds can be turned in any direction from which sounds may come. Many aquatic Mammalia are furnished with small cartilaginous valves to close the aperture of the ear when the animals dive, and the auditory organs in the Cetacea have an arrangement quite different from that of any other members of the class, which will be described when we come to treat of that order. The sense of *taste* also must be possessed in greater perfection by the Mammalia than by any other group of Vertebrata, for it is in them that the tongue acquires its most fleshy consistency, and is most abundantly supplied with nerves. The general sense of *touch* is, of course, most acute in those parts of the body which are destitute of hair, and covered with a soft and delicate skin; but in a great many Mammalia we find special tactile organs developed in the form of long bristles projecting from each side of the upper lip; these, which are commonly known as whiskers, are abundantly supplied with nerves, and are evidently most delicate organs of touch.

The mode in which the process of reproduction is effected in the Mammalia, is, as we have already stated, the leading point of difference between these animals and the other Vertebrata. All the Mammalia are essentially viviparous animals; the young are always born alive, although generally in a very helpless condition. In this, however, as we have seen, the Mammalia are not peculiar, for several animals belonging to the truly oviparous classes of fishes and reptiles produce living young; but these are all destitute of the peculiar provision for the nourishment of their offspring, which renders the latter completely dependent upon its mother for its support for a considerable period after birth; and as nothing approaching this is found in any other group of animals, it has been very judiciously fixed upon as the distinguishing characteristic of the class.

This provision for the support of the young is the *milk*, a fluid secreted by peculiar glands called the *mammary glands*, which become greatly developed in the female during the period of gestation. These glands are situated upon the ventral surface of the body, sometimes on the breast, sometimes in a double row along the whole lower surface, and sometimes only in the inguinal region. When situated on the breast, these organs are only two in number, and they are generally placed in this position in

those animals, such as our own species, the apes, and bats, in which the anterior members are of such a form that the young may be supported in them. The elephant, however, is a striking exception to this rule. In the ordinary Mammalia the mammæ are far more numerous; the dog is commonly furnished with ten, and some of the other species have a still greater number. The glands themselves consist of immense numbers of small secreting cells, each furnished with a minute duct; and these gradually uniting, lead into a sort of reservoir, in which the milk is stored up until the young animal requires its nourishment. From these milk is discharged through one or more openings situated in larger or smaller cutaneous projections, called nipples, which the young animal takes in its mouth when it sucks. The presence of these nipples is consequently always characteristic of a mammal, and none of these animals are without them.

In those species of the oviparous classes of reptiles and fishes in which the young are brought forth alive, the only difference between the process of reproduction and that which prevails in the majority of their respective classes, consists in the fact that the former retain their ova within the oviducts until the complete development of the young animal. The ova, as in the truly oviparous species, are provided with an abundant supply of nourishment for the evolution of the embryo, and it does not appear that any additional materials of importance are furnished by the mother during the development of her progeny. In the Mammalia, however, the case is widely different. The ova of these animals on quitting the ovary are of very small size, and the materials of the yelk are not more than sufficient to support the embryo during the first moments of its development. This deficiency is made up from the fluids of the parent's body, by which the little animal is nourished during the whole period of its development, which is effected in the following manner:—

The oviducts, or *Fallopian tubes*, as they are frequently called, convey the ova from the ovaries into the uterus, or uteri; and during their passage through them the ova undergo certain changes, which it is unnecessary to describe here. Arrived in the uterus, the outer membrane of the ovum attaches itself to the walls of that organ, and the development of the embryo goes forward to a certain period, when a necessity for a different mode of nourishment arises. This is provided for by the development of a vascular connection between the embryo and the mother, called the *placenta*; and through this the young animal continues to derive the nutriment necessary for its growth until it attains its full development. In some of the Mammalia, however, this organ is never produced, and the young animals are born in the same condition as the embryos of the ordinary Mammalia at the period of the formation of the placenta.

**Divisions.**—The remarkable and important difference just referred to in the development of the embryo in the Mammalia has given rise to a division of this class into two great sections or sub-classes, the Placental and Aplacental Mammalia (*Mammalia Placentaria* and *Aplacentaria*). These two groups are distinguished not only by the physiological character indicated in their names, but also by structural characters of importance, which are quite sufficient to prove that this division of the class is perfectly natural.

### SUB-CLASS I.—APLACENTARIA.

**General Characters.**—The Aplacental Mammalia, as already stated, are those in which the embryo never forms a vascular connexion with the uterus of the mother, the ovum being simply retained within the uterus, and the requisite nourishment for the development of the young animal obtained by absorption. An analogous process

is supposed to take place in the ovoviviparous fishes; but the size of the young animal in comparison with the original yelk is much greater in the mammal than in the fish, and the necessity for a supply of nourishment from the mother must increase in the same proportion; so that the term ovoviviparous, applied to these Mammalia by many authors, is scarcely so strictly applicable to them as to the viviparous reptiles and fishes.

Although this character, being strictly physiological, does not in itself serve to distinguish an animal belonging to this group from a placental mammal, the imperfect state of the newly-born young, consequent on their somewhat premature introduction into the world, necessitates the provision of certain organs which furnish excellent characters for that purpose. Thus the great majority of the animals belonging to this sub-class are provided with a singular pouch situated under the belly, in which the teats are situated, and the young when born are introduced into this cavity, where they adhere firmly to the teats, and remain concealed until their development has proceeded sufficiently far to enable them to venture forth from their retreat. For the support of this pouch these animals are furnished with two bones, which pass up the front of the abdomen, resting upon the front of the pelvis (Fig. 316); and these bones (called *marsupial bones*) are found not only in the females, which alone possess the pouch, but also in the males. They also occur in the three members of the group, the females of which are destitute of the abdominal pouch; so that they may be regarded as characteristic of the Aplacental Mammalia.

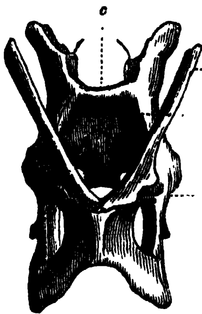


Fig. 316.—Pelvis of the Echidna; *c*, base of the vertebral column; *i*, iliac bone; *m*, marsupial bone; *f*, cavity for the head of the femur.

Another important character by which these creatures are distinguished from the members of the other sub-class is derived from the structure of the brain, which is always destitute of the great commissure, called the *corpus callosum*, which in the majority of the Mammalia unites the two hemispheres of the brain. The latter are usually smaller than in the other Mammalia, and leave the cerebellum and sometimes even the optic lobes, uncovered.

These animals, both in their mode of reproduction and in their general structure, evidently approach the oviparous classes, and they are accordingly placed at the bottom of the Mammalian series. At the same time they frequently exhibit, in many of their characters, a remarkable resemblance to the higher groups of Mammalia; so much so, in fact, that some naturalists have proposed to insert them amongst the other orders in those places, their title to which appeared to be indicated by their external characters and mode of life. In the present day zoologists are tolerably unanimous in regarding the Aplacental Mammals as a group apart, although offering many points of analogy with the higher orders. The Monotremata, however, are still placed by Wagner amongst the Edentata.

**Divisions.**—The Aplacentaria are divided into two very distinct orders. In one of these, which makes the nearest approach in its structure to the oviparous Vertebrata, the abdominal pouch is wanting, and the intestinal canal, and generative and urinary organs, all open, as in the birds and reptiles, into a common cloaca. From this circumstance these animals are denominated *Monotremata*. In the second order,

that of the *Marsupialia*, the general structure agrees more closely with that of the ordinary quadrupeds; the urinary and generative organs have a common orifice, which is quite distinct from the anal opening; and the abdomen, in the females, is furnished with a pouch for the reception of the young during their long infancy.

## Order I.—Monotremata.

**General Characters.**—The Monotremata show most distinctly in all their characters, a relationship to the oviparous Vertebrata. The bones of the skull, as in birds, are early united together in such a way as to obliterate the sutures. The cranium is very small in comparison with the facial bones, which project in a more or less beak-like form, and the jaws are not covered by soft, moveable lips, and are either entirely destitute of teeth, or furnished with substitutes for them in the form of small horny plates.

The bones of the shoulder (Fig. 317) are unlike those of any other Mammals, and appear to be intermediate in their arrangement between those of Birds and Reptiles. At the top of the sternum there is a T-shaped bone, formed by the union of the two clavicles, in the same way as the furcula of a bird; one of the three extremities of this bone rests upon the top of the sternum, whilst the other two are in contact with the acromion processes of the shoulder-blade. Besides these, the coracoid bones, which are reduced to the form of small processes of the shoulder-blade in the other Mammalia, are here of large size, and assist, as in the birds, in the support of the scapular arch, whilst the shoulder-blades themselves are produced beyond the socket of the humerus to such an extent that they also rest against the sternum.

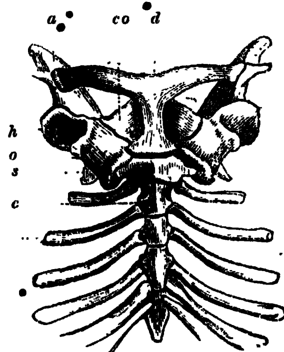



Fig. 317.—Sternal apparatus of the Ornithorhynchus. *a*, acromion process; *co*, coracoid bone; *d*, clavicles united; *h*, socket for humerus; *o*, scapula; *s*, sternum; *c*, ribs.

The eyes are of small size, and the external ear altogether deficient. The orifices of the alimentary, urinary, and generative organs, all open into a common cloaca, as in birds, and the whole structure of the female sexual organs is very similar to that of a bird.

The feet have five toes armed with long nails, and besides these the males are furnished with long spurs on the hind legs; at the base of these is a glandular organ, and the spurs are perforated, but it does not appear that there is any truth in the assertion that the wounds inflicted by them are venomous.

So little is known of the habits of these animals, that it was long considered doubtful whether they did not produce eggs instead of living young, and even at the present day, the condition in which the young are born, and the way in which they contrive to obtain their natural nourishment are still matters of dispute. The orifices of the mammary glands are not elevated into nipples, but consist of simple slits in the skin of the abdomen.

**Divisions.**—This order includes only three species, all natives of Australia, which, however, form two families, the *Ornithorhynchidæ* and the *Echidnidæ*. In the former, which includes a single species, the *Ornithorhynchus paradoxus*, the jaws

exactly resemble a flattened duck's bill, opening freely to a considerable extent and covered with a thick skin. The lower jaw is a good deal narrower than the upper one, and its edges are furnished with small transverse lamellæ, which greatly increase its resemblance to the bill of a duck. Near the base the jaws are furnished on each side with a sort of horny tooth, which, however, is quite destitute of a root, and apparently of a very different nature from the ordinary teeth of the Mammalia. The tongue is of a very singular construction; it is divided into two parts, of which the hinder is broad and flat, covered with soft papillæ, whilst the anterior portion is narrow and covered with upright points, which become longer and sharper towards the tip of the tongue. The hinder division of the tongue also has a free process which projects over the base of the anterior division, and bears two pointed horny teeth. The nostrils are placed at the apex of the upper mandible.

The skin is covered with a short brown fur, which extends also upon the short flattened tail. The legs are short, and each furnished with five toes, which are united by a membrane; this, on the anterior feet, projects in a semi-circular form beyond the extremities of the claws. The spurs on the hind legs of the male are of considerable size; but, notwithstanding the assertions of the natives that they inflict poisonous wounds, European observers have never found that the animals used them in self-defence.

This extraordinary animal, which was supposed by its first describer, Dr. Shaw, to be a manufactured monster, is found in New South Wales and Van Diemen's Land, where it inhabits ponds and the quiet parts of streams. In these places it swims about on the surface of the water, with the head a little raised, diving continually in search of the insects and other small aquatic animals on which it feeds. It is also able to climb with facility, and may often be seen in small parties resting on trunks of trees overhanging the water. It digs itself a burrow in the banks of the piece of water frequented by it, making it with two openings, one above and the other a little below the surface of the water. The burrows are of great extent, usually from twenty to thirty-five feet in length, and Mr. Bennett,—to whom we are indebted for most of our knowledge of this interesting creature,—mentions his having seen one no less than fifty feet long; they rise from the water towards the surface of the earth, and at the furthest part, which is also the highest, are slightly enlarged and provided with a sort of nest for the reception of the young. These, when born, are quite blind and nearly naked.

For many years it was a disputed point amongst zoologists whether the *Ornithorhynchus* produced eggs or living young, and even when the distinguished anatomist, Meckel, pointed out the existence of what were apparently mammary glands, several of his contemporaries refused to believe that these were really what they seemed to be, especially as at the same time it was stated that the eggs had actually been found in Australia. Observations on the living animal, however, have proved that the office of these glands is really the secretion of milk, and as the stomachs of the young animals have been found filled with that fluid; and no remains of egg-shells have ever been discovered in the nest with young animals which were evidently just brought into the world, there is no longer any reason to doubt that the *Ornithorhynchus* brings forth its young alive and suckles them in the same way as other Mammalia. The principal argument employed in opposition to this view was, that from the form of the mouth the young animal would find it impossible to suck, but it is now proved that the structure of the mandibles and tongue are exceedingly different in the young and adult animals, all the differences being evidently intended to enable the former to procure its nourishment from the mammary glands of its mother. According to M. Verreaux, the young,

at a later period of their lives, and when they are able to swim about, obtain their milk in a singular manner. The milk, he says, is pressed out in the water, on the surface of which it floats, producing an iridescent spot, which is then sucked off by the young creature. In confinement the young *Ornithorhynchi* are as playful as puppies, and will feed freely upon rice and egg, or soaked bread, chopped egg, and finely minced meat. Mr. Bennett found that they readily climbed to the top of a book-case, by placing their backs against the wall and their feet to the back of the book-case. The *Ornithorhynchus* is usually a little more than eighteen inches in length.

The family of the *Echidnidæ*, or Porcupine Ant-eaters, includes only two species, which, like the *Ornithorhynchus*, are found in New South Wales and Van Diemen's Land. In many respects these animals resemble the *Ornithorhynchus*, but they differ from that curious creature in several important particulars. Thus the snout, instead of taking the form of a flattened duck's bill, is produced into a nearly cylindrical organ, of which both mandibles are enclosed in a continuous skin, except just at the apex, where there is a small orifice to allow of the protrusion of the tongue. The latter organ, by an arrangement of longitudinal and annular muscles, which we shall see repeated in the true Ant-eaters, is capable of being extended and contracted to an immense extent, so that it may be exserted from the mouth to a length of nearly eight inches, and retracted till it is entirely concealed. The jaws are entirely destitute of teeth, and the nostrils, as in the preceding family, are placed at the end of the snout. The legs are short and strong, and the feet all furnished with five toes, armed with powerful claws, but destitute of the swimming membranes which form so remarkable a feature in the *Ornithorhynchus*. The body is short and thick, the tail is reduced to a very small size, and the skin is clothed with bristly hairs, intermixed on the upper surface with numerous short, acute spines, very similar to those of the Hedgehog. The structure of the mammary glands of the female, and the spurs on the hind legs of the male, is the same as in the *Ornithorhynchus*.

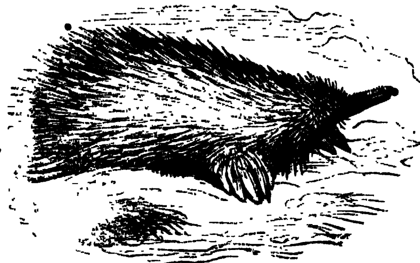


Fig. 318.—Echidna hystrix.

Of the two species belonging to this family one, the *Echidna hystrix* (Fig. 318), is certainly peculiar to New South Wales; and the other, *Echidna setosa*, is said to be proper to Van Diemen's Land, although, according to Mr. Waterhouse, it is also found in New South Wales. They measure from fifteen to eighteen inches in length, and are found generally in hilly countries, where they live in burrows and feed upon insects, principally ants and termites, which they capture by the protrusion of their long sticky tongues. They are slow, dull, nocturnal animals, but exhibit a wonderful activity in digging, for which their powerful claws are admirably adapted. When surprised, they either make their escape by burrowing into the earth, or roll themselves up in the manner of a hedgehog, so as to expose their spiny covering to the enemy.

## Order II.—Marsupialia.

**General Characters.**—This order includes a considerable number of species, the majority of which are inhabitants of Australia, although a few are found in the warmer

parts of America. They exhibit a great variety of structure and habit, and the families into which they are divided often differ from each other as much as the orders of the Placental Mammalia. Thus the arrangement and form of the teeth and the structure of the extremities vary exceedingly in the different families, and these subordinate groups are here often distinguished by characters of the same nature as the orders of the higher forms.

From these the Marsupialia are of course distinguished by the characters already given for the sub-class, and their principal points of difference from the Monotremata may be given in a few words. One of the most important consists in the separation of the orifices of the urino-genital apparatus and alimentary canal, which no longer discharge themselves into a common *cloaca*. Another character is the possession by the female of a more or less complete pouch, situated in the under part of the abdomen, within which the teats are inclosed, and which serves for the protection of the immature young. Here they remain suspended to the teats during the earliest periods of their existence, and in many cases they also retreat to this natural shelter when alarmed, long after they have begun to lead an independent life. The marsupial bones are thus called into requisition for the support of the sac, with its contained young ones; but we nevertheless find these bones in the males, in which no such office is to be performed. It is found, also, that the mammary organs in the female marsupial animals are furnished with peculiar muscles, destined, by their contraction, to promote the flow of milk into the stomach of the young, which in their early ages appear not to possess the strength requisite to obtain this nourishment by the ordinary process of sucking. It is remarkable, also, that, in order to provide the young animal with the means of breathing whilst engaged in this perpetual, and to a certain extent involuntary sucking, the larynx is prolonged upwards to the aperture of the posterior nares, where it is embraced by the soft palate. By this arrangement the air passages are completely separated from the fauces, and the milk passes down into the œsophagus, without any danger of interfering with respiration. In some cases, also, the teat itself passes into the pharynx, and this would render such an arrangement as the above still more necessary.

The skull is very variable in form, but is always composed of separate bones united by sutures, and the jaws are always furnished with teeth. The orbits generally open posteriorly into the space included by the zygomatic arch. The external ears are always present and often greatly developed, and, lastly, the arrangement of the bones of the scapular arch is similar to that of the ordinary Mammalia.

The first traces of the existence of Mammalia upon the earth consist of the fossil remains of animals of this order. They make their first appearance in the Stonesfield slate, and in the gypsum of Paris; so that during the formation of these strata, that part of the earth which we now call Europe was inhabited by animals of a type which, in the present day, is entirely confined to Australia, a few of the Indian islands, and America.

**Divisions.**—The Marsupialia may be divided into two great sections,—the *Phytophagous*, or plant-eating, and the *Rapacious* or carnivorous and insectivorous groups. These two sections are well characterized by the structure and arrangement of the teeth. In the former the canine teeth are small and sometimes altogether wanting in one or both jaws, the incisors on the contrary are large, but never more than two in number in the lower jaw, and the molars are furnished with broad, tubercular crowns. This section includes three families.

The first of these is the family of the *Phascolomydæ*, including only a single species, the curious Wombat (*Phascolomys fossor*) an inhabitant of Van Diemen's Land and the small islands in Bass's Straits. In the arrangement of the teeth, the Wombat presents a considerable resemblance to the Rodentia or gnawing Mammalia; the incisors are two in number in each jaw, and of the same chisel-like form as in the Rodentia; the canine teeth are entirely wanting, so that there is a considerable gap between the incisors and the molars. The latter exhibit a curious structure; a deep furrow down the inside of the upper, and the outside of the lower ones, divides each tooth into two upright prisms; the surface is smooth and surrounded by the enamel. The total number of teeth is twenty-four. The intestine is furnished with a short cœcum, and with a vermiform appendage.

The Wombat is an exceedingly plump animal, between two or three feet in length, and covered with a thick coat of long, brownish, dull woolly hair. Its head is large and broad, and presents a considerable resemblance to that of a Rabbit. The tail is excessively short and nearly naked. The legs are short and nearly of equal length, and the feet are furnished with five toes, all of which, except the small inner toe of the hind feet, are armed with long claws. The animal walks upon the soles of the feet, which are broad and naked.

It is a slow moving nocturnal creature, living in holes amongst the rocks, or in burrows which it digs for itself in softer ground,—and from its burrowing habits it is known to the colonists as the "badger," although it agrees with the true Badgers in no other particulars of its œconomy. Its food consists entirely of vegetable matter, such as grass and roots, the latter of which it digs up with its strong claws. It is a quiet creature, and may be easily domesticated; its flesh is said to be exceedingly delicate. Several specimens have been brought to Europe. The female produces three or four young at a birth, and is said to take the greatest care of them.

The second family is that of the *Macropodidæ* or Kangaroos, which are at once distinguished amongst the Marsupials by the structure of the hind legs. These organs are exceedingly long and powerful, and the feet, which are much elongated, rest with their whole sole upon the ground; the fore legs on the contrary are very short, and are of little use to the animal in progression, its movements consisting in powerful leaps effected by the extension of the hind legs. In its natural position the Kangaroo sits upright upon its haunches with the assistance of its powerful tail, which with the two hind feet forms a sort of tripod. In opposition to this great development of the hind parts of the body, all the fore parts are exceedingly small, so that some fanciful observers have compared the animal to a creature compounded out of portions of two others of very different bulk.

The head is small, and furnished with good large ears, and the upper lip is cleft. The dentition is very different from that of the Wombats, and in some respects resembles that of the Horse. There are six incisors in the upper jaw, but only two in the lower; the canines are always deficient in the lower jaw, and very small in the upper, where they are also sometimes wanting or concealed by the gums; so that there is always a considerable space between the incisors and the molars, which are five in number on each side, and of a more or less quadrangular form. The anterior feet are furnished with five toes, each of which is armed with a claw; the hind feet on the contrary only possess four toes, the inner one or great toe being deficient. Of these the two outer are the largest, and are terminated by strong hoof-like nails, whilst the inner ones are united together as far as the root of the nails.

With regard to the structure of the internal organs, we may observe that the stomach is of a complex structure, being divided by constrictions into several compartments. The object of this arrangement is not clearly known; but Professor Owen has observed a sort of rumination to take place in some species. The cœcum attains a considerable size, but is destitute of the vermiform appendage.

The Kangaroos are almost entirely confined to Australia and Van Diemen's Land; but species are found in the adjacent islands, and even in New Guinea. They are



Fig. 319.—Great Kangaroo (*Macropus Giganteus*).

entirely herbivorous, and live for the most part in the grassy plains; but some species, forming Dr. Gray's genus *Petrogale*, are found in rocky places. They are timid creatures, but when seized defend themselves with violent strokes of their hind feet, which, from their great power and the strength of their nails, constitute formidable

weapons. Unlike the generality of herbivorous animals, however, they do not usually collect into flocks, although they may sometimes be seen in considerable numbers together. In feeding, they rest upon the fore feet, and when thus engaged, the young, which frequently retreat to the abdominal pouch long after they are able to graze like their parents, may often be seen protruding their heads, and cropping the herbage at the same time with the mother. According to Quoy and Gaimard, they also run on all fours when pursued by dogs. Their ordinary mode of progression, as already mentioned, consists in long leaps, effected by the agency of the hind legs alone, and in these efforts the long powerful tail is employed in maintaining their equilibrium.

The Tree Kangaroos (*Dendrolagus*), of which two species are found in New Guinea, differ remarkably from the rest of the family by their adaptation to an arboreal life.

The size of the animals belonging to this family varies greatly, some of the largest species being more than four feet long in the body, whilst the smallest are about the size of a small rabbit or large rat. Of the latter description are the Kangaroo Rats (*Hypsiprymnus*), little nocturnal animals, which feed to a great extent on roots.

The flesh of the larger species of Kangaroos (*Macropus giganteus*, Fig. 319, *M. nemoralis*, *M. fruticus*, and others), is esteemed excellent food both by the natives and colonists of Australia, and that of several of them is commonly seen in the markets of Sydney. The colonists hunt the Kangaroo with powerful dogs, and the sport is of an exciting description, as the animal not only endeavours to escape by exerting his utmost speed, but also, when the dogs come close up to him, strikes powerful blows at them with his tail. When seized by the dogs, he also frequently wounds them severely with his hind feet.

The native Australians take these animals in a variety of ways. Sometimes a number of them go out in company to hunt the Kangaroo; sometimes they take them in pitfalls and snares, or kill them with spears when they come to drink. Another mode, which is probably the most usual of all, is described in a most graphic and picturesque manner by Captain Grey. The native advances quietly in the direction where he expects to find his game, with every sense on the alert to give him early notice of its approach. When the animal is near him, he is seen to assume an attitude of intense attention, and, at a given signal, his wives and children, who accompany him, drop immediately upon the ground. When the savage is thus occupied, Captain Grey says, you will see at about a hundred yards from him "a Kangaroo erect upon its hind legs, and supported by its tail; it is reared to its utmost height, so that its head is between five and six feet above the ground; its short paws hang by its side, its ears are pointed—it is listening as carefully as the native, and you see a little head peering out from its pouch, to inquire what has alarmed its mother. But the native moves not; you cannot tell whether it is a human being or the charred trunk of a burned tree which is before you, and for several minutes the whole group preserve their relative position; at length the Kangaroo becomes reassured, drops upon its fore paws, gives an awkward leap or two, and goes on feeding, the little inhabitant of its pouch stretching its head further out, tasting the grass its mother is eating, and evidently debating whether or not it is safe to venture out of its resting-place, and gambol about amongst the green dewy herbage.

"Meantime the native moves not until the Kangaroo, having two or three times resumed the attitude of listening, and having, like a monkey, scratched its side with its fore paw, at length once more abandons itself in perfect security to its feed, and

playfully smells and rubs its little one. Now the watchful savage, keeping his body unmoved, fixes the spear first in the throwing-stick, and then raises his arms in the attitude of throwing, from which they are never again moved until the Kangaroo dies or runs away. His spear being properly secured, he advances slowly and stealthily, no part moving but his legs; whenever the Kangaroo looks round, he stands motionless in the position he is in when it first raises its head, until the animal, again assured of its safety, gives a skip or two, and goes on feeding. Again the native advances, and this scene is repeated many times, until the whistling spear penetrates the devoted animal."

Besides the flesh, the skin of the Kangaroo is highly valued, as the leather made from it is admirably adapted both for shoes and gloves. The best leather is said to be afforded by the skin of the Bush Kangaroo (*M. fruticus*) of Van Diemen's Land; this is the only kind which the more fashionable members of society in Sydney will condescend to have in their boots and shoes, and accordingly immense numbers of the skins are annually imported into New South Wales from Van Diemen's Land.

The third and last family of the phytophagous marsupials is that of the *Phalangistidæ*, or Phalangers, which resemble the Kangaroos to a considerable extent in their dentition, but differ from these in their complete adaptation for an arboreal existence. Thus the hind legs are only of a proportionate length to the anterior limbs, and all the feet are furnished with five toes; the second and third toes of the hind feet are, however, united together. The incisor teeth are six in the upper and two in the lower jaw; the canines are small, and the lower jaw is sometimes quite destitute of them. The stomach, unlike that of the Kangaroos, is simple in its construction, and the intestine is furnished with a very long cœcum. The tail is usually very long, but in one genus, on the contrary, it is reduced to a mere rudiment.

These animals, of which the largest measures about three feet in length, including the tail, occur in Australia and many of the islands of the Eastern Archipelago. They live in woods, climbing about with great agility amongst the branches, in which the long-tailed species assist themselves by clinging with the tail. They are nocturnal in their habits, and, like most nocturnal animals, are furnished with large eyes; during the day they sleep rolled up into a ball. Their food consists of fruit and leaves; but it also appears probable that they may occasionally prey upon birds, which they surprise at night roosting in the trees, as they have been found in confinement to prefer meat to any other food. They are said to emit a most disagreeable odour; but are nevertheless regarded as excellent food by the natives of the countries in which they occur, who appear to capture them in great numbers. According to some writers, indeed, their capture is very easy, as, when they are found suspended by their tails to the branches, it is said they may readily be made to descend by looking fixedly upon them for some time.

Of the true Phalangers (*Phalangista*) there are two groups, in one of which the tail is entirely covered with bushy hair, whilst in the other the extremity is naked. It is remarkable that each of these groups is exactly circumscribed in its geographical distribution, the species with the tip of the tail bare being confined to the islands of the Eastern Archipelago, whilst those in which the whole organ is clothed with hair are found only in Australia and Van Diemen's Land. The species of both groups are tolerably numerous, especially those of the latter; and several of the species occur in the greatest abundance. The natives of the Molucca Islands call them *Cuscus*, or *Cousous*; and in New Ireland the natives give the name of *Capoul* to their common

species (*P. cavifrons*). The common species in Australia (*P. vulpina*) is well-known to the colonists as the Opossum; it is nearly two feet long in the body, and its flesh is a favourite food with the natives, who hunt it with great success.

The Flying Phalangers (*Petaurus*) are distinguished from the True Phalangers, which they resemble in most respects, by the possession of a broad fold of skin which runs down each side of the body from the anterior to the posterior limbs, and which, when stretched by the extension of the legs, serves as a sort of parachute to support the creature in springing from one tree to another. It cannot, however, fly, in the true sense of the word. The tail is long and bushy, and is destitute of the prehensile power possessed by that of the True Phalangers. They are pretty little creatures, the largest measuring about two feet long, including the tail, which makes about half its length; whilst the smallest species is not larger than a mouse. The fur is soft and fine, and that of one species (*P. sciureus*) is in considerable esteem amongst the Australian colonists. The Flying Phalangers are found only in Australia and New Guinea; one species occurs in Norfolk Island, but none in Van Diemen's Land.



Fig. 320.—The Koala (*Phascolarctos cinereus*).

We have already mentioned that in one genus of this family the tail is reduced to a mere stump; this is the genus *Phascolarctos*, of which two species are recorded, both natives of New Holland, where they are known to the colonists under the names of "monkeys" and "bears." The only species of the habits of which we know anything is the Koala (*P. cinereus*), which inhabits the woods of New South Wales. It is about two feet in length, and covered with a soft gray fur; the ears are adorned with tufts of long hairs. Like the other Phalangers it lives on trees, and is a slow nocturnal creature, feeding principally on the tender shoots of particular trees, and also occasionally descending to the ground in search of roots. Its flesh is highly esteemed by the natives of Australia, who climb the highest trees in its pursuit. When the young have become too large for their ordinary retreat in the pouch of the mother, they mount upon her shoulders, and are carried about by her in this position.

From the Phalangers, of which most, if not all, subsist to a certain extent upon animal food, we pass by an easy transition to the rapacious Marsupials. These are at once distinguished from the vegetable feeders by the nature of their dentition. The incisors are small, and present in considerable number in both jaws; the upper jaw bears from eight to ten, and the lower from six to eight of these teeth. The canines also are always large and present in both jaws, and the true molars are furnished with several points. This section of the order includes four families.

In the first of these, the *Peramelidæ*, or Bandicoot Rats of Australia, there are six incisor teeth in the lower jaw, and eight or ten in the upper; the true molars are four in number on each side in each jaw, and between these and the canines there are three

false molars. The total number of teeth is consequently forty-six or forty-eight; the latter number prevails in the typical genus *Perameles*. The form of the molars agrees with that observed in the Insectivorous Placental Mammalia, with which the Bandicoots seem to correspond.

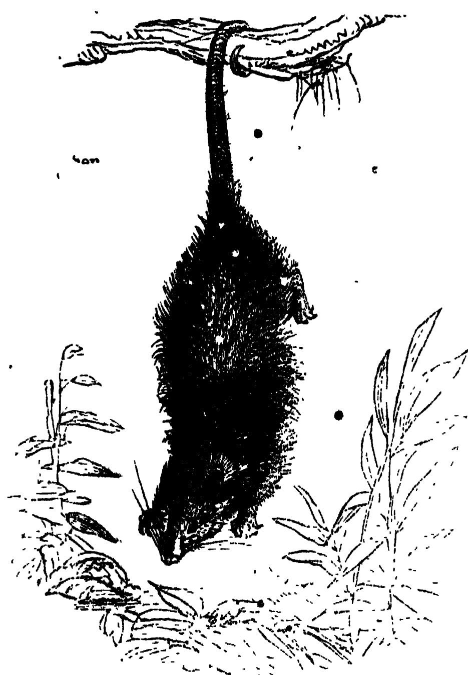


Fig. 321.—Crab-eating Opossum (*Didelphys cancrivora*).

The structure of the limbs is remarkable, the hind legs being much longer than the anterior pair, and adapted for leaping, like those of the Kangaroos. The fore feet are composed of five toes, but the two outer are reduced to the form of small tubercles placed very far back, and concealed amongst the hair; they are, however, furnished with minute nails. The feet consequently appear to consist only of three toes, which are completely separate, and armed with strong digging claws. In the genus *Chœropus* this number is even reduced to two. In the hind feet the inner toe is rudimentary or entirely wanting (*Chœropus*); the second and third are completely united, and the two outer toes are the largest and separate.

The Bandicoots are small animals, which inhabit different parts of Australia and Van Diemen's Land. They are nocturnal animals, which dig themselves burrows in the soft ground, for which purpose their claws are well adapted; and from this circumstance and the unusual length of its ears, one of the species (*P. lagotis*) is called the "rabbit" by the colonists of Swan River. The flesh of the animal is said to resemble that of the Rabbit, but their food is generally of a very different nature, consisting principally of insects and grubs, although some species are said to have a particular predilection for roots, and especially bulbs. Their gait consists of a series of hops, in which, however, they are said, like the Rabbit, to use their fore feet.

The *Didelphidæ*, or Opossums, forming the next family, are peculiar to America; and to this group belonged the first examples of Marsupial animals with which Europeans were acquainted. The dentition in these animals is remarkable, as they alone, of all the Marsupials, possess eight incisors in the lower jaw. In the upper jaw there are ten of these teeth; and as, in addition to the canines, there are four true and three false molars on each side of each jaw, the total number of teeth amounts to no less than fifty. The head is long and pointed, with large, rounded, and nearly naked ears. The feet are all composed of five toes, furnished with small claws; the inner toe of the hind feet forms an opposable thumb, and is destitute of a claw. The

tail is naked and scaly, except at the base, where it is clothed with fur like that on the body, and its tip forms a prehensile organ of great power. The females are sometimes provided with a regular pouch, but more commonly this is replaced by two folds of skin.



Fig. 322.—Virginian Opossum, with its Young (*Didelphys Virginiana*).

The Opossums are found in all parts of America, from the state of La Plata in the south to the shores of the Great Lakes in the north; but they are most abundant in the warm regions of South America. They live in the woods and forests, and exhibit great skill in climbing trees, an operation in which their hand-like hind feet are a great assistance to them. Their prehensile tails are usually employed only to suspend them from the branches, and in this position, with the head downwards, they will often remain for hours. They are nocturnal in their habits, and generally slow in their movements. Their food consists of small animals, such as mice, birds, and insects; they are fond of the eggs of birds, and are said also to feed on fruits. They are also particularly partial to blood, for the sake of which they sometimes commit serious depredations in hen-roosts. The young, on leaving the pouch, are usually carried about for some time on the back of the mother, where they steady themselves by twisting their tails round that of their parent.

The Opossums are all of small size; the largest species measure from two feet to two feet and a half, including the tail, which is about as long as the body; the smallest species is not more than seven inches in length. The flesh of the larger species is eaten, and is said to be white and good, although many people have a prejudice against it, on account of the very rat-like character of the tail. When threatened with danger they counterfeit death most admirably, and may even be picked up or injured without giving any sign of life.

The earliest known species was the Virginian Opossum (*D. Virginiana*, Fig. 322), the only representative of this group that inhabits North America. It is generally distributed in the United States, and is abundant in the southern parts of the Union. It is one of the larger species. The true Opossum (*D. Opossum*) is exceedingly common in Guiana, but rare in Brazil, where one of the commonest species is the Crab-eating Opossum (*D. cancrivora*, Fig. 321), which is also one of the largest of the group. It is said to prefer marshy districts, and to be exceedingly fond of Crabs.

We must also refer to another South American species, the Yapock (*Chironectes variegatus*, Fig. 323), which is distinguished from the ordinary Opossums by its

palmated hind feet, which enable it to swim and dive with facility, and by several other characters, which may, perhaps, entitle it to rank as the type of a distinct family.



Fig. 323.—The Yapock (*Chironectes variegatus*).

In its form, this curious little animal has a good deal of resemblance to the Otters, and was originally described by Buffon as the "little Otter of Guiana." It also resembles those animals in its habits, seeking its food, which consists of small fishes, aquatic insects, and crustacea, in the water, and living in holes in the banks. It is said to be furnished with cheek pouches, in which it stows away its food until its return to the shore, and possesses another remarkable character, in the presence of a peculiar process of the pisiform bone of the wrist, which gives it the appearance of having the rudiment of a sixth finger, as which it was indeed described by Temminck.

The family of the *Myrmecobiidæ* includes only a single species, the *Myrmecobius fasciatus*, or Banded Ant-eater, an inhabitant of the southern and western parts of Australia. It is distinguished from all the other Marsupials by the great number of its teeth, which are more numerous even than those of the Opossums. This increase is in the molars, of which there are five on each side in the upper jaw, and six in the lower; between these and the canines there are three false molars in each jaw, and the incisors are eight in number in the upper, and six in the lower jaw. The total number of teeth is consequently fifty-two. The molars are furnished with small pointed tubercles like those of the ordinary insectivorous quadrupeds, which this animal resembles in its food.

The head of the *Myrmecobius* is terminated in front by a pointed snout and furnished with narrow pointed ears. The anterior feet have five and the posterior four toes, all furnished with strong claws, and the tail is rather long and bushy. Its feet are formed for running on the ground, where it progresses by successive leaps like a squirrel; but when pursued it usually takes refuge in the hole of a tree.

Its food consists of insects, which it is said to collect in the same way as the true Ant-eaters and the *Echidna* by protruding its long tongue, and it is generally found in districts containing many Ant-hills, no doubt for the sake of the abundant supply of food which it obtains in such situations. The female is destitute of a pouch, but the young when adhering to the teats, are said to be concealed by the long hairs which grow upon the belly of the mother. It is an elegant little creature, measuring about eighteen inches in length, including the tail; the anterior parts are of a reddish tawny colour, and the hind part of the back is adorned with transverse bands of black and white.

In the preceding families the cæcum is of moderate size, but in the following one it

is entirely wanting. This is the family of the *Dasyuridæ*, or Dasyures, including the most carnivorous species of the Marsupial series, which it completes. The teeth are usually forty-six in number, and agree in their arrangement with those of the Opossums, except that there are only eight incisors in the upper and six in the lower jaw. In the typical genus *Dasyurus*, however, there are only two false molars between the true molars and the canines, so that the total number of teeth is reduced to forty-two. The form of the molars in the upper jaw is usually irregularly triangular, with three points; but those in the lower jaw are compressed cutting teeth, the edges of which are also furnished with three points. The feet are formed for terrestrial progression; the anterior have five toes and the posterior four, all perfectly separate and armed with curved claws. The deficient toe of the hind feet is sometimes represented by a sort of tubercle, which, however, does not reach the ground. The tail is of moderate length, or elongated, and always well covered with hair. This family includes the largest of the rapacious Marsupials. They are evidently analogous to the ordinary carnivorous quadrupeds, not only in their ferocity and carnivorous propensities, but also more or less in form.

A striking instance of this is presented by the Pouched Wolf (*Peracyon* or *Thylacinus cynocephalus*), which, both in its general form and the structure of its extremities, closely resembles a large Dog or Wolf. It is of a yellowish-gray colour, with transverse black bands on the hinder part of the back, whence it has obtained the names of the "Zebra Wolf," the "Hyæna," and the "Tiger" from our colonists in Van Diemen's Land, to which island it appears to be exclusively confined. It is a most carnivorous animal, often committing considerable ravages amongst the flocks of sheep, but it has now become rather rare, except in the wildest and most inaccessible parts of the colony, where it lives amongst the caves of the mountains and feeds upon the smaller Kangaroos and other Mammalia. It is even said sometimes to devour the *Echidna*, notwithstanding his spiny protective coat. It is a strictly nocturnal animal. Remains of an animal nearly allied to this (*Thylacotherium*) have been found in some of the secondary strata in Europe.

Of the typical Dasyures (*Dasyurus*) the largest species (*D. ursinus*) is also a native of Van Diemen's Land, where it is commonly known amongst the colonists by the name of the "Devil." It is about eighteen inches long in the body, and is covered with a long, thick, coarse hair, of a black colour, with a few white spots on the breast and shoulders. It is of a most savage nature, and is often destructive to sheep, to which its powerful jaws render it a most formidable enemy, notwithstanding its comparatively small size. When Van Diemen's Land was first colonized, the "Devils" were very abundant, and did much mischief amongst the poultry, but they are now for the most part banished to the woods in the unfrequented parts of the country, where they exercise their destructive propensities on the small wild quadrupeds and birds.

In the genus *Phascogale*, which includes several small Opossum-like animals, with bushy tails, the first toe of the hind foot, instead of being absent or quite rudimentary, is of sufficient length to be employed as a thumb in grasping, and these animals consequently ascend trees with facility in the pursuit of the insects which constitute their food. One species of this genus is smaller than our common Mouse.

## SUB-CLASS II.—PLACENTARIA.

**General Characters.**—It will be unnecessary to enter at any length upon the characters of this group, as their leading peculiarities are the same as those of the

class; these they exhibit in their highest degree of perfection, the connexion between the mother and the young being continued for a much longer period than in the Aplacentaria, so that the young animal when born is in a far more perfect state, and, in fact, in some instances is able to walk almost from the moment of its introduction into the world. The principal distinctions by which this sub-class is separated from the preceding one consist in the absence of the ventral pouch and marsupial bones, and in the presence of the great commissure, or *corpus callosum*, uniting the hemispheres of the brain. In other respects, the numerous animals forming this group present an extraordinary diversity of structure, and the orders into which they are divided are in consequence very numerous.

**Divisions.**—The first order consists of the strictly aquatic Mammalia, in which the body is fish-like in its form, with the anterior members converted into fins, and the hinder limbs entirely wanting; these are called *Cetacea*. The three following orders are distinguished by having the toes encased in hoofs, or so completely enveloped in the integuments, that their divisions are completely concealed, and the only external evidence of their existence is to be found in the hoof-like nails with which the foot is provided. Of these the *Pachydermata* have always two or more toes in each foot, indicated as above stated by the number of hoofs, and the skin is usually naked and furnished only with a few scattered bristles. In the *Solidungula* the legs terminate in a single toe, with an undivided hoof; and the *Ruminantia* are characterized by their cleft hoofs, the absence of incisor teeth in the upper jaw, and the peculiar structure of the stomach, which enables them to return their food into the mouth, and submit it to a second mastication.

The fifth order of the True or Placental Mammalia appears, to a certain extent, intermediate between the Ungulate forms and the Unguiculate orders which make up the remainder of the class, their long curved claws being hollowed out at the base, so as to enclose the extremities of the toes much in the same way as a hoof. They are further distinguished by the total absence of incisor and canine teeth in both jaws. These are called *Edentata*.

Of the *Unguiculata*, or clawed Mammalia, the *Rodentia* are distinguished by the absence of canine teeth, and by their chisel-like gnawing incisors. In the *Pinnipedia* the canines are greatly developed, and the molars compressed and sharp-edged, indicating the carnivorous propensities of the animals; whilst the body is fish-like in form, and the four limbs are converted into paddle-like organs. The *Carnivora* have limbs adapted for ordinary terrestrial progression, with the toes armed with sharp claws; and the teeth are adapted for cutting flesh. The *Insectivora* resemble the Carnivora in many respects; but their molar teeth are broad, and furnished with several pointed tubercles. In the *Chiroptera* the anterior extremities are converted into wings, by the expansion of a leathery membrane between the elongated fingers. The *Quadrumana* are furnished with grasping hands on all four extremities; whilst the *Bimana*, including only the human species, have the anterior limbs alone provided with hands.

## Order III.—Cetacea.

**General Characters.**—This order, which includes the Whales and some allied animals, is distinguished, as already stated, by the fish-like form of its members, which are thus adapted for passing their existence in the water. The Cetacea are generally very bulky creatures, in which the head is often of a most enormous size; the body tapers off posteriorly, and is terminated by a broad tail fin, which, like that of the

fishes, is the principal agent in swimming, but is set on in the contrary direction, being transverse instead of perpendicular (Fig. 324). This caudal fin is supported upon a firm cartilaginous basis, but has no trace of rays or bones. The anterior limbs are converted into powerful fins, completely enclosed in an uniform skin; but beneath this we find the usual bones of which the arm of a vetebrated animal is composed, although considerably shortened. In some instances the phalanges are very numerous, but the fingers rarely exhibit any traces of nails. The posterior limbs are entirely wanting, and the only trace of the pelvis consists in a pair of bones suspended amongst the muscles, and usually united in front into the form of a V, but completely detached from the vertebral column, which is also destitute of that peculiar series of anchylosed vertebræ called the sacrum, which serves in the ordinary Mammalia to give firm support to the pelvis. The first caudal vertebræ are, however, distinguished from the lumbar by the presence of a series of small inferior V-shaped arches; these disappear towards the extremity of the tail.

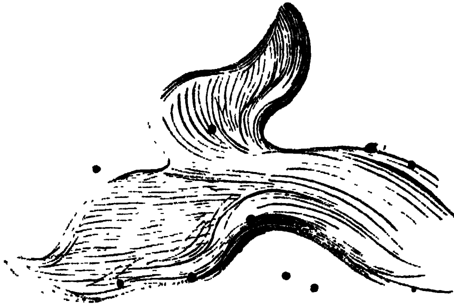


Fig. 324.—Tail of the Whale.

The head is not separated from the body by a neck, although the cervical vertebræ are distinctly marked in the skeleton; the great bulk of the head is made up of the facial bones, the cranial portion being often very small. The nostrils are sometimes, as in other vertebrated animals, placed on the fore part of the nose; but in the typical forms these orifices are brought quite to the top of the head, constituting what are called the *blow-holes* of the Whale. The external ear is entirely wanting, and the mode in which the auditory of the organs of the Cetacea are adapted for the perception of sounds both in the water and in the air is very interesting. The external aperture of the ear is exceedingly small, so as to prevent any injury to the organ from the rush of water when the creature is progressing rapidly through that element, although it apparently allows of sufficient access of water for the communication of any sounds that may be transmitted by its means. The air penetrates into the ear through the Eustachian tube, which is of large size, and opens into the blow-hole; and thus, when the Whale is at the surface of the water and breathing, aërial sounds can readily find their way into the ear. The eye is of very small size when compared with the bulk of the animal, and, from the immense development of the facial bones, it often appears to be placed nearly in the middle of the body.

The skin is naked, or only sparingly covered with scattered bristles; but to make up for the want of the ordinary clothing of the Mammalia, the whole surface of the body beneath the skin is covered with a thick coating of fat, or *blubber* as it is termed, which forms a most efficient agent in preserving the temperature of the body, at the same time that it reduces its specific gravity. It is this blubber, which is often present in enormous quantity, that forms the principal object for which these creatures are pursued. The Cetacea are all inhabitants of the sea. They are divisible into two very distinct groups, or sub-orders.

## SUB-ORDER I.—CETE.

In the first of these, consisting of the true or typical Cetacea (the Whales, Porpoises and their allies), the body is peculiarly fish-like in its form, the teats, two in number, are placed on the belly, and the nostrils on the top of the head. Of the latter there are sometimes two and sometimes only one; they do not appear to serve as organs of smell, but must be regarded merely as respiratory apertures, and orifices for the expulsion of the water taken into the mouth with the food of the creatures. The complicated and wonderful mechanism by which these different objects are effected, may be briefly described as follows:—The larynx is produced into a conical form, and when the creature is breathing projects into the cavity of the posterior nares, where it is embraced by the muscles of the soft palate, and thus a free passage is opened through the nostrils from the lungs to the external air, although nearly the whole head may be under water, and the mouth perhaps filled with that fluid. In getting rid of the water taken into the mouth, the animal performs the act of deglutition, but at the same time closes the pharynx to prevent the passage of the water beyond the necessary point; it is thus forced up into the nasal passages, which are furnished with large folded and dilatable cavities for its reception, and it is by the sudden forcible contraction of the muscles surrounding these, that the water is finally forced out in a jet.

The expiration of air is performed in the same way, and as the air when driven from the lungs is charged with a great quantity of moisture, it produces an appearance which has probably often been mistaken for a jet of water; indeed, some distinguished naturalists have maintained that the stories of the expulsion of water from the blow-holes of Whales are fables resting merely upon errors of observation. It appears pretty certain, however, that the above account is correct.

The head in these creatures is of very large size, sometimes forming nearly one-half of the entire body; the skull is usually unsymmetrical, the bones of the right side being rather larger than those of the left. A remarkable peculiarity presented by the skull is that the petrous bone, which usually forms a part of the temporal bone in the Mammalia, in these animals is only attached to the skull by cartilage. The mouth is exceedingly wide, and the jaws usually armed with numerous conical teeth; the only exceptions to this rule are found in the *Balænidæ*, or Whalebone Whales, which, in the adult state, are furnished with a peculiar arrangement of horny plates, although in the early periods of their existence, the jaws exhibit distinct conical teeth. The skin is perfectly naked, and beneath it lies a layer of blubber, which in some of the large species attains an enormous thickness.

Although the Cete all subsist upon animal food, it is remarkable that they possess a complex stomach, which consists of at least four compartments, and sometimes of as many as seven. The object of this arrangement is not known.

This group includes the largest of known animals. From their abundance in all seas they have been generally known in all ages, and as commonly regarded as fish. They are, however, in all respects true members of the class Mammalia, producing their young alive (usually only one at a birth) and suckling them for a considerable period. They appear to be quite destitute of voice, and the majority are sociable animals, swimming in large shoals together, and sporting frequently on the surface of the water. They occur most abundantly in the Arctic and Antarctic Seas.

**Divisions.**—The Cete or typical Cetacea are divided into three families. The

first of these is the family of the *Balænidæ*, or true Whales, in which the teeth are deficient, and the mouth is furnished with numerous plates of a horny substance, well known as *Whale-bone* or *baleen*. The arrangement of these plates in the mouth of the Whale is as follows:—Along the centre of the palate runs a strong keel, on each side of which is a broad depression, along which the plates of baleen are inserted. These are long flat plates, attached by their bases to the palate, and hanging down freely into the cavity of the mouth (Fig. 326); they are placed transversely in the mouth, so that their sides are parallel and at a very small distance from each other. The base and outer edge of each of these perpendicular plates is composed of solid whale-bone, but the inner edge terminates in a fringe of fibres which fill up the interior of the mouth. The object of this structure is readily understood when we consider the mode in which the Whale procures its food. This enormous animal, although strictly an animal-feeder, and provided with an immense mouth, has an œsophagus so small that he is compelled to nourish his vast bulk by the consumption of some of the smallest inhabitants of the sea: his food consists, for the most part, of the small swimming Mollusca (*Clio borealis*) and Crustacea, so abundant in the Arctic seas, and it is said he never indulges his stomach with anything larger than a Herring. To procure these insignificant morsels he engulphs a whole shoal of them at once in his capacious jaws, where they are of course entangled amongst the fibres of the baleen; the water is then strained off and expelled through the blow-holes, and the monster is thus enabled to pass his diminutive prey at his leisure into his stomach. The baleen, in fact, forms a complete sieve, through which the Whale strains the water from his food. The lower jaw is entirely destitute of teeth and furnished with large fleshy lips, within which the upper jaw, with its apparatus of horny plates, is received when the mouth is closed.

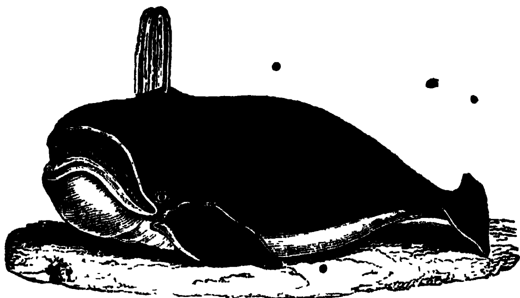


Fig. 325.—The Greenland Whale (*Balæna mysticetus*).

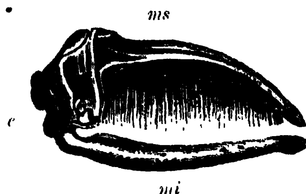






Fig. 326.—Skull of Whale with Baleen. *c*, cranium; *ms*, upper jaw; *mi*, lower jaw; *a*, single plate of baleen.

This family includes two genera. In the typical genus *Balæna*, the back has no fin, whilst in the *Balænopteræ* there is a small fleshy dorsal fin. The most important species is the Greenland or Right Whale (*B. mysticetus*, Fig. 325), in pursuit of which a great quantity of shipping is annually despatched into the Arctic Seas from different European ports, but especially from this country. Some of the

older naturalists described the Whale as attaining a length of nine hundred feet, and it is still asserted by some writers that specimens are to be met with in the present day of eighty or a hundred feet, and that before the fishing had been pursued so far, they occasionally attained double this size. Mr. Scoresby, however, whose testimony is deserving of the highest confidence, states that he never saw a Whale of more than sixty feet long, and that the largest he ever heard of, measured less than seventy feet; he also quotes authorities from voyages of the sixteenth and seventeenth centuries, showing that the length of what was regarded as a large Whale, and the quantity of oil yielded by it was the same in those days as at present. The tail of a large Whale measures about twenty or twenty-five feet in breadth and five or six feet in length; by the action of this powerful instrument it can dash off with immense velocity, when wounded or alarmed, and sometimes with a single blow from it completely shatters the boats of its pursuers. Its pace at ordinary times is said to be about four miles an hour, and it appears rarely to swim at any great depth in the water. At times, for amusement, these enormous creatures will spring completely out of the water, and another of their diversions consists in immersing the whole body perpendicularly and flapping their immense tails on the surface of the water, so as to produce a sound that may be heard at a distance of two or three miles.

The Greenland Whale is found in most parts of the Arctic Seas; but its exact limits are not known, as it has probably often been confounded with the other species of *Balæna*. The fishery, as it is termed, is now principally carried on in Baffin's Bay; and almost entirely by the English, who are calculated to have a capital of at least a million sterling embarked in this enterprise. The ships reach their stations about the end of April, and immediately begin looking out for Whales. As soon as one of these creatures is perceived from the mast head, the boats, of which each ship carries six or seven, are lowered and manned for the pursuit. When one of them arrives sufficiently close to the enormous animal, the harpooner, who stands at the head of the boat plunges his weapon into its body, and the rowers immediately back out of harm's way. The Whale dives down immediately with such velocity that, when he has taken a perpendicular direction, he has been known to fracture the bones of his head against the bottom at a depth of 800 yards; but more commonly he makes off for the shelter of an ice-field, dragging out with him the line to which the harpoon is fastened, and this passes so rapidly over the edge of the boat, that it is necessary to keep it constantly wet to prevent ignition. The lines are usually about 4000 feet in length, but the whale often takes out three or four times this length of line. The wounded Whale usually remains under water for about half an hour, but sometimes much longer; and one instance is recorded in which the creature was an hour and a-half before coming up to breathe. On his reappearance, he is again attacked with harpoons and spears, by which he is soon despatched, the destruction of one of these monsters of the deep rarely taking much more than an hour. The body is then towed to the ship's side, where the process of *flensing*, or cutting off the blubber and removing the baleen, is performed, and when this is completed, the carcase is left to the tender mercies of the White Bears, Water-fowl, and Sharks.

But the European whalers are not the only enemies of this inoffensive creature even the savage natives of these inhospitable regions do not fear to attack it in their frail boats, and with none of those appliances which in the case of Europeans certainly diminish, although they do not destroy, the chances of danger.

Thus the natives of the Aleutian Islands paddle close up to the Whale, and plunge

a spear into his body beneath the anterior limbs, when, if the weapon penetrates to a sufficient depth, the animal is sure to die in two or three days, and his body is then thrown upon the shore by the waves. In this way, however, a great unnecessary loss of life is inflicted, for a large proportion of the Whales wounded are never seen again. In the year 1831, we are told that out of 118 Whales mortally wounded in this manner, only forty-three were recovered.

The blubber covers the surface of the Whale to a thickness of from eight or ten to twenty inches, and that of a large Whale will weigh about thirty tons, furnishing from twenty to twenty-five tuns of oil. Whales have been taken which gave thirty tuns of oil. This is worth on an average £30 per tun. The number of Whales has been rapidly diminishing of late years, and the whalers have, in consequence, been compelled to extend their voyages to a higher latitude, a proceeding which, of course, increases the peril of the undertaking, whilst the results become more and more uncertain. Nevertheless in the year 1850 the quantity of oil, blubber, and spermaceti imported into this country was no less than 21,328 tuns; but this, of course, includes the produce of the southern whale fisheries.

The whalebone, or baleen, is also an important part of the whale. The longest laminæ in a large whale usually measure about twelve feet in length, but they are sometimes found no less than fifteen feet. The whole quantity obtained from one animal weighs sometimes as much as a ton and a-half, and it is worth about £160 per ton. The number of plates is usually about six hundred, but large individuals have been found with eight hundred plates of baleen in the upper jaw.

To the natives of the inclement regions of the north the Whale is a still more important animal than to Europeans. They not only use the oil for lighting and warming their dwellings, but also drink it with avidity, and both the blubber and the flesh are favourite articles of food with them. Indeed, the flesh of a young whale when roasted and eaten with pepper and salt is said to be very good, and not unlike beef; but that of the older animals is black and coarse. From the internal membranes the Esquimaux prepare some of their articles of clothing, and also a semi-transparent substance which serves instead of glass for the windows of their dwellings; and the bones and baleen are also applied by them to various useful purposes.

The affection of the female for her offspring is most extraordinary. The young Whale when just born measures from ten to fourteen feet in length, and for a twelvemonth or more after its birth it remains in close attendance upon its mother. It furnishes but little oil, and the whalers, therefore, do not care to take it for its own sake; but as it is easily harpooned, it is frequently struck in order to attract the mother to its assistance. Mr. Scoresby gives an interesting account of the devotion of the parent to its young under these circumstances. He says—"In June, 1811, one of my harpooners struck a sucker, with the hope of its leading to the capture of the mother. Presently she arose close by the "fast boat," and, seizing the young one, dragged about a hundred fathoms of line out of the boat with remarkable force and velocity. Again she arose to the surface, darted furiously to and fro, frequently stopped short, or suddenly changed her direction, and gave every possible intimation of extreme agony. For a length of time she continued thus to act, though closely pursued by the boats; and, inspired with courage and resolution by her concern for her offspring, seemed regardless of the danger which surrounded her. At length, one of the boats approached so near that a harpoon was hove at her. It hit, but did not

attach itself. A second harpoon was struck; this also failed to penetrate; but a third was more effectual, and held. Still she did not attempt to escape, but allowed other boats to approach; so that in a few minutes three more harpoons were fastened; and in the course of an hour afterwards she was killed." Our author seems to regard it as an act of barbarity to kill a creature at the moment of its exhibiting this excess of maternal affection, which, as he says, would do honour to a rational being; but he justifies the practice by the consideration of the great value of even a single Whale, and the dangers to which the men expose themselves in the pursuit, from which he argues they can scarcely be expected to allow feelings of pity to interfere with the object of their voyage.

Occasional specimens of the Whale have been stranded upon our northern coasts, but always in a poor condition, which showed that they had wandered far from their native seas.

The Southern Whale (*B. australis*) has the head much smaller in proportion than the Greenland Whale; in the latter, the head forms nearly one-third of the length of the body, whilst in the Southern species it is not more than one-fourth. Its size is nearly equal to that of its northern relative, the usual length being about fifty feet, although specimens of seventy feet long have been mentioned. According to the Japanese, however, the large Whales of this species attain a length of thirty metres, or nearly a hundred feet; but this is evidently an exaggeration. The Southern Whale is an inhabitant of the great Southern Ocean, where it generally keeps near the coasts, and in rather shallow water, extending up the shores of the Pacific to Japan and Kamtschatka, and on the eastern side of America as far as the United States. It is also abundant on both the shores of the African continent. The females visit the bays on the coasts frequented by them in the months of June and July, for the purpose of producing their young, and it is then that they are taken in considerable numbers for the sake of their oil. The principal fisheries are on the coasts of New Zealand and South Africa; but from the victims being always of one sex, their numbers are rapidly diminishing.

The *Balænopteræ*, or Fin-backed Whales, are distinguished from the preceding by the possession of a soft dorsal fin. They are also characterized by the shortness of the plates of baleen, which in animals of the same size do not measure twice as many inches as those of the Greenland Whale do feet. Their food is of a more substantial nature than that of the true *Balænæ*, consisting almost entirely of small fishes. The largest species is the *Balænoptera Boops*, which is known to measure sometimes as much as one hundred feet in length, and is probably the largest of all known animals, living or extinct. Another species, the *B. musculus*, an inhabitant of the Mediterranean, occasionally attains a length of nearly eighty feet. Notwithstanding their vast bulk, these Whales furnish comparatively little oil; and as their great activity renders their capture a matter of danger and difficulty, they are generally avoided by the whalers, although the species are found abundantly in most seas. The largest species, commonly known as the Fin-fish and the Rorqual (*B. boops*), occurs not unfrequently on the British coasts.

The second family is that of the *Physeteridæ*, or Sperm Whales, which are distinguished from the true Whales by the absence of baleen plates in the palate, and the presence of from forty to fifty conical teeth in the lower jaw. This is shorter and narrower than the upper jaw, so that when the mouth is closed it is completely enclosed by the upper lip. The teeth fit into cavities of the upper jaw, which,

although not quite destitute of teeth, possesses these organs in a very rudimentary condition, and concealed in the gums. The head, as in the true Whales, is of enormous size, forming about one-third of the entire length of the animal, and its form is exceedingly remarkable. It is nearly cylindrical, and singularly truncated in front, and the blowhole, instead of being placed on the forehead, is situated on the anterior portion of this immense snout. The mass of this part of the head is not composed of bone, but of a sort of cartilaginous envelope, containing an oily fluid, which hardens by exposure to the air, and in this state is well known as *spermaceti*. This substance is also diffused through the blubber.

The only well known species of this family is the Sperm Whale, or Cachalot (*Physeter macrocephalus*), which is very generally distributed in all seas, but principally in those of the Southern Hemisphere. The male is of immense bulk, usually measuring about sixty feet in length; and specimens have been met with no less than seventy-six feet long, and thirty-eight in circumference. The females are much smaller, usually measuring from thirty to thirty-five feet in length.

The Sperm Whales inhabit the deep water, and very rarely approach the land. Their food consists principally of Cuttle fishes, which swarm in great profusion in the southern seas. They usually swim in flocks, called *schools* and *pods* by the whalers, consisting of from twenty to fifty females and young, accompanied by one or two old males, to which the seamen give the name of *bulls*. They are taken in great numbers, as the oil obtained from their blubber is the finest of the animal oils, and is much used for burning in lamps, and the oily matter from the head (*spermaceti*) is also of great value, both as an ointment, and for the manufacture of candles. Another substance of still greater value, obtained from the Sperm Whale, is the well-known perfume called *Ambergris*. This is a morbid concretion formed in the intestine of the Sperm Whale, either in the stomach, or more probably in the gall-ducts, as in its nature it appears to resemble a gall-stone. It forms masses of considerable size, sometimes as much as thirty or forty pounds in weight; and is usually found floating upon the surface of the water, probably disengaged from the decomposing body of one of these monsters. The whalers rarely seek for it in the intestines of the Sperm Whales which they kill, although its value is about a guinea an ounce. It has the singular property of increasing the power of other perfumes when mixed with them, and it is for this purpose that it is principally employed.

Valuable as these creatures are their pursuit is attended with danger in fully equal proportion. They are harpooned from boats in the same way as the true Whales, and, like these, frequently use their tails as most formidable offensive weapons; but in this case the other members of the flock will often come to the assistance of their wounded comrade, and thus add greatly to the peril of the boatmen. There are cases on record of men being struck out of the boats and killed by the powerful tails of these creatures; and in other instances the Whales have been known to rush against the ships with such violence as to spring leaks, which have caused them to sink within a few hours. The Sperm Whale occurs occasionally in the British seas, which are also inhabited by what has been regarded as a second species, to which the name of the High-finned Cachalot (*P. Tursio*) has been given, from the great development of the dorsal fin, which was compared by Sibbald to the mast of a ship. The distinctness of this species is denied by many naturalists, but Mr. Bell thinks there is good reason for its retention.

The *Delphinidæ*, or Dolphins, forming the third family of the *Cete*, or true Cetacea,

are at once distinguishable from the great Whales by the more proportionate size of the head, which usually forms about one-seventh of the total length of the animal. The form of the body consequently becomes more regularly fish-like than in the preceding families, and the jaws are for the most part armed with numerous conical teeth. This family includes numerous species, which are found abundantly in all parts of the globe, many of them enjoying a tolerably wide geographical distribution. They are usually far inferior in size to the gigantic creatures belonging to the preceding families, ten or twelve feet being their ordinary length, although a few species attain a length of thirty feet. They are active creatures, and generally live in considerable flocks, swimming and playing on the surface of the sea, and sometimes leaping quite out of the water. Some of the species appear to find great pleasure in swimming about ships, and generally accompany them for a considerable distance, when their gambols afford a good deal of amusement to the passengers on board. The ancients were well acquainted with this habit of the Dolphin, which they regarded as, in an especial manner, the friend of man; and the writings of the poets of antiquity abound with allusions to it. The food of the Delphinidæ consists almost entirely of fishes and Cuttle-fishes.



Fig. 327.—The Porpoise (*Phocæna communis*).

The commonest species is the well known Porpoise (*Phocæna communis*), which is found abundantly all round our coast, and occurs in all the European seas as far as the icy regions. The Porpoises pursue the Herrings, and other fish that swim in shoals, with great avidity, and not unfrequently advance far up our tidal rivers in pursuit of their prey. Their length is from four to eight feet, and when in the water they present a considerable resemblance to large black pigs, whence they are frequently called *Sea-hogs* and *Hog-fish*. The name of Porpoise is also said to be derived from the French *Porc-poisson*, or Hog-fish; the German *Meer-schwein* has the same meaning, and the French name *Marsouin* is evidently derived from some old Teutonic form of the same word. In places where the Porpoises are abundant they are often caught for the sake of the oil which they afford; their flesh is also eaten, and all the other species of the family are occasionally taken for the same purposes. The Grampus (*Phocæna Orca*), another British species nearly allied to the Porpoise, is of a much larger size, measuring sometimes no less than nineteen feet in length. It is a voracious animal, feeding not only upon fishes, but also upon the smaller Cetacea; there appears, however, to be no reason for putting any faith in the accounts of the older naturalists, who accuse the Grampus of attacking the Whale in flocks and worrying him to death.

The Round-headed Porpoise (*Phocæna melas*) is another large species, which is remarkable for its exceedingly gregarious habits, and for the strong attachment manifested by the different members of the flocks towards each other. This species usually measures about twenty feet in length, but specimens have been seen of twenty-four feet long. It is distinguished by its very convex rounded head. It occurs in the northern seas in vast flocks; Mr. Bell records one of these which was run ashore in Iceland that consisted of eleven hundred and ten individuals, and as many as seven hundred and eighty have been captured in one shoal in the Shetlands. In the capture of these animals the boatmen are greatly assisted by the strong instinct which prompts

the Porpoises to follow one another like a flock of sheep; so that when the leader of the flock has run upon the beach, all the rest are pretty sure to follow his example. To drive them on shore all the boats in the neighbourhood go out and surround the shoal, upon which they gradually close until their victims are driven on shore, where they are quickly despatched; and the sea is frequently deeply tinged with blood during one of these massacres. The bellowings of the animals are also described as fearful. The Shetlanders call this Porpoise the "Ca'ing Whale," the meaning of the former word being "driving."

Nearly allied to the Ca'ing Whale is the Beluga, or White Whale (*Phocæna leucas*), a northern species, which measures from twelve to eighteen feet in length. When adult it is of a white colour, sometimes with a yellowish or rosy tinge. It feeds on fish, and its flesh, which is said to be very good, is eaten by the inhabitants of the northern coasts. It is very rare in the British seas.

The True Dolphins have the snout produced into a sort of rostrum, which is separated from the forehead by a transverse depression. The best known species is the Common Dolphin (*Delphinus Delphis*), which abounds in all the seas of the Northern Hemisphere. It measures six or eight feet in length, and is one of the most active species of the family. This species, as already stated, is noted for its fondness for accompanying ships in considerable flocks, sporting upon the surface of the water as if for the delectation of the beholders. It is said that in these gambols specimens have been known to leap out of the water to such a height as to fall upon the deck of a ship.

One of the most remarkable species is the Narwhal, or Sea Unicorn (*Monodon monoceros*), an inhabitant of the northern seas, where it grows to a length of about fifteen feet in the body. The jaws of this animal are quite destitute of the ordinary conical teeth of its allies. The male, however, is furnished with an extraordinary horn of great length, which projects from the centre of the upper jaw, and is in fact one of the incisor teeth remarkably developed, the other remaining concealed within the jaw. It forms a long straight pointed pole of ivory, the surface of which is spirally twisted throughout; its length is usually six or seven feet, but in some instances it has been known to be ten feet long. Like the tusks of the Elephant, it grows from a permanent pulp, so that it continues increasing throughout the life of the animal; and although only one tusk is usually developed, instances have occurred in which both had attained a nearly equal length. The tusks are also sometimes developed in the females. This remarkable organ is probably a weapon with which the male Narwhal is enabled to defend the females under his care; and, when propelled with the utmost force of his powerful body, it must render him a most formidable opponent; indeed it is said that the Narwhal has sometimes driven his tusk deep into the timbers of a ship. The food of this species consists of Mollusca.

Amongst the numerous exotic species, which resemble their northern allies in their general habits, we may notice one which is remarkable for living wholly in the fresh waters. This is the *Inia boliviensis*, an inhabitant of the great rivers of South America, where it is found at a great distance from the sea, and in situations which the intervention of cataracts would prevent its reaching if it were a native of the salt waters. The females usually measure six or seven feet in length, the males twelve or fourteen. They swim in small shoals, pursuing the fishes with which the South American rivers abound, and are in their turn captured by the Indians for the sake of the oil which they furnish.

The Gangetic Dolphin, or Soosook (*Platanista Gangetica*), is another species which frequents fresh waters; it occurs in the Ganges as far as that river is navigable, but is most abundant in the numerous mouths through which its waters pass into the sea. It is consequently a less strictly fluviatile species than the Amazonian Dolphin.

In the oldest tertiary strata of America the bones of a gigantic extinct Cetacean animal have been discovered, the dentition of which differs so much from that of any existing forms, that it has been regarded as the type of a distinct sub-order, the *Zeuglodonta*. The teeth are compressed and furnished with two roots, whence the name *Zeuglodon* applied to the animal. When first discovered they were supposed to belong to some gigantic reptile, and the name of *Basilosaurus* was given to their unknown possessor; but the subsequent discovery of an entire skeleton has proved the Cetacean nature of this enormous animal, which measured about seventy feet in length.

### SUB-ORDER II.—SIRENIA.

**General Characters.**—The *Sirenia*, or Herbivorous Cetacea, exhibit in some respects a considerable affinity to the Pachydermata, and especially to the Elephants; they have indeed been placed in that order by De Blainville and some other geologists. The majority, however, following Cuvier, regard them as forms of Cetacea, with which they agree in their most important characters.

They nevertheless present several important differences from the *Cete*, or Whale-like animals forming the preceding sub-order. Thus the nostrils are placed on the front of the snout, in the same position as in most other Mammalia; the nasal cavities present nothing of the remarkable arrangement which prevails amongst the typical Cetacea; and the nostrils are, consequently, never employed as blow-holes. The molar teeth, which are present in all except one species, are furnished with broad crowns, with transverse folds of enamel, forming a regular grinding surface; and the teats, instead of being placed upon the belly, in the neighbourhood of the anus, are removed forwards upon the breast, near the fins. The head is of moderate size, and more distinctly separated from the trunk by a neck than in the preceding sub-order; the mouth is enclosed by thick fleshy lips, and the skin covered with scattered bristles.

All these characters point more or less to an affinity with the Elephants; but the general form of the body, the absence of the posterior members, the conversion of the anterior limbs into fins, and the presence of a broad transverse tail-fin at the hinder extremity of the body, seem to indicate a still more close connexion with the Cetacea.

The bones in these animals are dense and heavy, whilst those of the true Whales are light and spongy. The heart presents a most singular structure, its two auricles being separated by such a deep cleft that the organ presents two points, and appears as though composed of two separate hearts.

The Sirenia inhabit the sea shores, especially about the mouths of rivers, up which they sometimes penetrate to some distance. They feed entirely upon sea weeds and aquatic plants, and do not, as stated by some authors, quit the water to pasture on the shore. They are said frequently to support themselves in an upright position with the upper part of the body out of the water, when they are said to present a somewhat human appearance at a distance, the illusion being assisted by the long whiskers which usually project from the upper lip, and the pectoral mammæ of the females. It is supposed by Cuvier, and many other naturalists, that the lively imaginations of the

ancient mariners raised upon this slight foundation all the wonderful stories of Tritons and Sirens, Mermen and Mermaids, that we meet with in the old writers.

**Divisions.**—In this sub-order we have only two families. The first is that of the *Rhytinidæ*, which only includes a single species, the *Rhytina Stelleri*, or Northern Manatee, which, like the Dodo, has become extinct, but at a much more recent period. This singular animal was distinguished from the other herbivorous Cetacea by the total absence of true teeth, the only masticating organs which it possessed being a pair of bony plates in the anterior portion of the mouth, one of which was attached to the palate, and the other to the lower jaw. The *Rhytina Stelleri* measured about twenty-five feet in length and about twenty feet in girth at the thickest part. The skin was of a very remarkable nature. The true skin was not more than a sixth of an inch thick, of a soft texture, and whitish colour; but this was concealed beneath an epidermic coat, which often attained an inch in thickness, and was composed entirely of perpendicular horny tubes analogous to hair. This epidermis was of a blackish-brown colour, and very rough and strongly wrinkled on the sides, so that it had no small resemblance to the bark of a tree; it was so exceedingly tough that an axe would not penetrate it without difficulty.

This most remarkable creature was discovered in the year 1741 upon the shores of an island in Behring's Straits, on which Behring's second expedition was shipwrecked; its flesh formed the principal food of the unfortunate mariners who were compelled to pass ten months in that inclement latitude; but although surrounded with everything that could discourage a man, one of the party, M. Steller, contrived to prepare a most admirable account of the animal, which was afterwards published in St. Petersburg, although the author did not live to superintend the publication of his treatise. In honour of this indefatigable observer, his name has been appended to the animal of which he furnished such an excellent account, and this probably contains all we shall know of it, as the islands near which it occurred were soon afterwards visited by numerous ships in pursuit of the Sea Otters which abounded there, and the crews killed these large Cetaceans in such numbers, for the sake of their flesh, that it is said the last *Rhytina* was destroyed in 1768, within twenty-seven years of the first discovery of the species. The only remains of this animal at present known consist of a skull, and a few other fragments, in European museums.

The *Manatidæ*, or Sea Cows, are always furnished with molar teeth, and when young with two incisor teeth in the upper jaw; the latter are permanent in one genus (*Halicore*), but fall out at an early period in the other (*Manatus*). The skin is always more or less covered with scattered bristles. The habits of these animals, which are peculiar to the tropical seas, have already been described under the characters of the sub-order.

In the true Manatees, or Lamantins (*Manatus*), the molar teeth vary in number from eight to twelve on each side of each jaw, and the caudal fin is of a rounded form. They are confined to the Atlantic Ocean, two species inhabiting the American coasts, and one occurring on the west coast of Africa. The largest species (*M. latirostris*), which inhabits the Gulf of Mexico, and extends as far as Florida and the West Indies, measures fourteen or fifteen feet in length, and is said even to attain a still larger size. The African species (*M. senegalensis*) does not exceed eight or nine feet. The South American species (*M. australis*) occurs about the mouths of the great rivers of that continent, and usually measures nine or ten feet in length. All the species occur in considerable abundance, and are pursued with avidity by the natives of the respective

countries on whose coasts they live, for the sake of their flesh and oil. Humboldt states that the flesh of the South American species is excellent, and furnishes a most welcome article of food to the Roman Catholics of Brazil, as it is regarded by the Church as a fish, and may consequently be eaten on fast-days. When salted, and dried in the sun, it will keep for a whole year. The oil of this species is also excellent in quality, and quite free from smell; its skin is cut into harness, and frequently also into whips, which are much dreaded by the unfortunate slaves in those countries.

On the east coast of Africa, and on all the shores of the Indian Ocean, the place of the Manatees is taken by the Dugong (*Halicore cetacea*), in which the molars are never more than five on each side in each jaw, whilst in old animals their number is reduced to two. The form of the upper jaw in this animal is very remarkable; it is bent downwards in front of the lower jaw, and terminated by two rather large incisor teeth (Fig. 8). The tail is notched. In its habits the Dugong resembles the Manatees, but it exceeds these animals in size, full-grown individuals measuring eighteen or twenty feet in length. It is found on the coasts of the Indian Ocean, especially amongst the islands of the Eastern Archipelago, and on the north coast of Australia, where the natives kill them in considerable numbers. Westwards it extends to the Red Sea and the east coast of Africa, but it does not appear to be known north of the Eastern Archipelago, on the coasts of China and Japan.

The skulls of several species of gigantic animals have been found in the tertiary strata of different parts of the world, which are referred by Palæontologists to the present sub-order. Amongst these we shall only refer to the remarkable *Dinotherium*, of which the skull has been found on the banks of the Rhine. This animal appears to have been more than equal to the Elephant in size, and like that quadruped it was furnished with a pair of long tusks; but these projected from the end of the lower jaw, which is curved downwards at a right angle to the body of the jaw; the tusks were thus directed downwards, and it is supposed that the animal employed them to support his head upon the shore. The molar teeth are broad, and furnished with notched transverse ridges; and the nasal cavity is of very large size, as in the Elephant; from this and other circumstances it is supposed that the *Dinotherium* was furnished with a short flexible trunk.

## ORDER IV.—PACHYDERMATA.

**General Characters.**—With the Pachydermata we commence the series of Ungulated or Hoofed Quadrupeds, and this order may be defined as including all the Ungulata, which do not ruminate, and have more than one hoof on each leg. It consequently includes a great variety of forms, some of which, indeed, seem to have very little to do with the rest, but in many cases the apparent gaps between the different families are filled up by the fossil forms, which show that it would be difficult to arrange them otherwise than in a single group. This multiplicity of forms, however, renders it almost impossible to give positive characters for the group.

We have already mentioned that each foot is furnished with more than one hoof, and that the animals do not ruminate. The most striking character is the thick and usually naked skin with which they are covered, and from this the name given to the order is derived. The mouth is almost always furnished with all three kinds of teeth; and the molars are broad, and adapted for grinding the vegetable matters which constitute the principal food of all the species.

The Pachydermata are, for the most part, inhabitants of the warmer regions of

the earth; they are generally of moderate or large size, only one very aberrant family being composed of small animals.

**Divisions.**—Professor Wagner divides the Pachydermata into three great sections—the *Anisodactyla*, the *Zygodactyla*, and the *Lamnunguia*. The *Anisodactyla* are distinguished by having the hoofs arranged in a single series round the bottom of the foot, and the animals walk upon the whole foot. The skin is usually naked. This group includes four families.

The first of these is that of the *Elephantidæ*, including the Elephants, the largest of existing terrestrial Mammalia. These animals, as is well known, are distinguished by the possession of a long trunk, or proboscis, which serves them in place of a hand, and enables them to perform many extraordinary feats, which have excited the admiration of mankind from a very early period. This proboscis consists of the nose, which is produced into a long muscular tube of great flexibility, and furnished at its extremity with a finger-like process, which adds greatly to its power of picking up small objects (Fig. 328). The skull is very large, but a great deal of its bulk is due to the enormous thickness of the bones of the cranium, the cavity in which the brain is lodged being of comparatively small size. These bones, however, are not solid, but their interior is occupied by large cells filled with fat, by which means the enormous skull is rendered sufficiently light to be no burden to its possessor, at the same time that its greatly increased surface affords the space required for the attachment of the powerful muscles of the proboscis. The lower jaw is also of immense size.

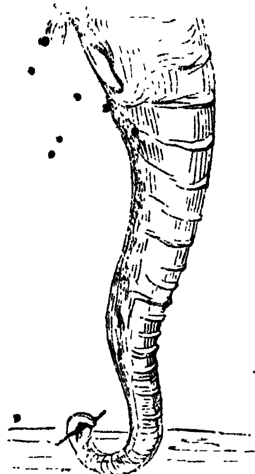


Fig. 328.—Trunk of the Indian Elephant.

The dentition of the Elephants is of a very remarkable nature. The upper jaw bears a pair of tusks, which often acquire an immense development in the males; they spring from the intermaxillary bones, and are, therefore, to be regarded as representatives of the incisors. They grow from a permanent pulp, and continue to increase in size during the life of the animal. The incisor teeth are wanting in the lower jaw, as are also the canines in both jaws, and the only other teeth possessed by this great quadruped consist of two molars, of a most remarkable structure, on each side of each jaw. These teeth are of a very large size, and of a quadrangular form. They consist of a series of transverse plates of the ordinary substance of teeth (*dentine*), each coated with a layer of enamel, and united together into a mass by a material softer than either of the others, called the *cement*. The form of these transverse plates of dentine and enamel varies greatly in the different species. The formation of the molar teeth, like that of the tusks, is going on as long as the Elephant lives, but with this difference, that whilst after the shedding of the first, or milk tusks, the pulp of each tusk continues adding matter to its base without any change, in the case of the molars, it is a succession of separate teeth that is produced, the hindmost passing gradually forwards to take the place of those which have been abraded by use, and cast off as unserviceable.

The Elephants are large, unwieldy animals, supported upon legs of considerable height and of great thickness. The feet are furnished with five flat hoofs, corresponding with the five toes which are distinctly recognizable in the skeleton, but which are completely concealed within the skin. The skin in the recent species is naked, with the exception of a few bristles in particular parts, and especially at the tip of the short tapering tail, which is terminated by a tuft of rather long bristles. The external ears are of large size, and hang down upon the sides of the head. The female possesses only two teats, which are placed upon the breast.

The existing species of Elephants are now confined to the tropical parts of the Old World, but at a period immediately preceding that in which the earth received its human population, gigantic quadrupeds belonging to this family inhabited the northern parts of both continents, and the remains of one species, the Mammoth (*Elephas primigenius*) occur in such plenty in Siberia, that their tusks constitute an important article of commerce in that desolate region.

Of the recent Elephants only two species are known, the Indian (*E. indicus*), and the African Elephant (*E. africanus*). They both live in considerable herds in the luxuriant tropical forests, feeding entirely upon vegetable substances which they convey to their mouths by means of their trunks, the total absence of cutting incisors rendering it impossible for them to graze in the manner of the ordinary herbivorous quadrupeds. With this extraordinary organ, as with a hand, the Elephant is enabled to twist the herbage from the ground and to strip the foliage from the trees, and as the shortness of its neck, and the conformation of its mouth prevent it from drinking in the usual way by immersing the lips, it sucks up the water into the hollow of the trunk, and then putting the end of this organ into its mouth, pours out the fluid which it contains. The water is prevented from passing back into the nasal cavities by a peculiar valve. The Elephant also frequently avails himself of this power of filling his trunk with water and again expelling it, to indulge in the luxury of a shower bath, by spouting the water over all parts of his body.

The Indian or Asiatic Elephant (*Elephas indicus*) has the forehead concave, the ears of moderate size, and the dentine and enamel of the teeth arranged in transverse bands. The males of this species are sometimes twelve feet in height at the shoulder, but the females rarely exceed eight feet. Both males and females are employed in the East as beasts of burden,—an office in which they exhibit extraordinary docility, especially when we consider that the animals have been reclaimed from a wild state, as the Elephant very rarely breeds in captivity. Their sagacity, though generally over estimated, is certainly very considerable, and a good sized volume might be filled with anecdotes illustrative of this quality in the Elephant. The wild Elephants are taken by driving or enticing them into a strong enclosure, from which they are released one by one, but only to be put into a still more disagreeable confinement. They are tied with strong ropes to the trunks of trees, and left in that uncomfortable condition until starvation and fetters have tamed them. In the capture of the wild Elephants the hunters are always assisted by tame ones, which appear to take a treacherous delight in depriving the others of their liberty. The females in particular will load the wild males with caresses, and thus by their blandishments seduce them into captivity.

The African Elephant (*E. africanus*) is confined to the southern parts of the African continent. It is distinguished from the Asiatic species by the convexity of its forehead, the enormous size of its ears, and the lozenge-shaped arrangement of the dentine and ivory in its molar teeth. It was formerly trained in the same way as the Indian

Elephant, and was undoubtedly the species known to the Romans, but in the present day it is never reclaimed. It is, however, pursued with great eagerness by the hunters for the sake of the tusks, which are of very large size, sometimes more than nine feet long, and furnish a beautiful ivory.

The Mammoth (*Elephas primigenius*), one of the extinct species, appears to have inhabited the most northern parts of the Asiatic continent at a comparatively recent period, for the carcase of one of these animals was found frozen in a bed of gravel at the mouth of the river Lena, in Siberia, with the flesh in such a state of preservation that it was devoured by the dogs and bears. The skin was covered with hair, so that it appears that the Mammoth must have lived in a climate much colder than that inhabited by our living species of Elephants. Vast quantities of the remains of this gigantic creature have been found in alluvial soil in Siberia; and the tusks, which sometimes measure eleven feet in length, are in such good condition that they are constantly used as ivory in Russia.

The Mastodons, the remains of a gigantic species of which have been found in alluvial soil in North America, also belong to this family.

The second family of the Pachydermata is that of the *Tapiridæ*, or Tapirs, in which the nose is produced into a short proboscis, and the skin covered with hair. The form of the head is very different from that of the Elephant, and the bones of the skull are entirely destitute of those cellular expansions, which contribute so much to the sagacity of that quadruped's appearance. The skull in the Tapirs is of a pyramidal form, somewhat like that of a Pig; but the nasal bones are much arched, to give support to the muscles of the proboscis. The jaws are fully furnished with teeth; there are six incisors and two small canines in each jaw; the upper jaw has seven and the lower six molars on each side.

The ears in the Tapirs are small, upright, and of much the same form as in the Pig; the neck is high, and furnished with a sort of stiff mane; the skin is clothed with short close hair; the tail is very short; and the fore feet are furnished with four and the hinder with three toes, all distinctly separated and terminated by nail-like hoofs.

In their form the Tapirs are not unlike Pigs, but their legs are considerably longer. They live in the moist tropical forests, generally sleeping during the day in the thickets, and wandering forth at night to feed on grass and other vegetable substances. They are also fond of the water, and swim well.

Three species of this family are known, of which two are inhabitants of South America, whilst the third is a native of Sumatra and the peninsula of Malacca. The best known species is the common American Tapir (*Tapirus Americanus*), which occurs in all parts of South America, from the Isthmus of Panama almost to the southern extremity of that continent. It is a large animal, measuring as much as six feet in length, and is of an uniform brown colour. It inhabits the forests, always in the neighbourhood of water, in which it delights to bathe, frequently rolling in the mud like a Pig. In unfrequented districts it is said to move about in the day time; but in the neighbourhood of human habitations it is more cautious, and rarely leaves its resting-place except at night. It frequently breaks into the cultivated grounds in large herds, when the destruction caused by the trampling of so many heavy feet is often very serious. The second South American species (*Tapirus villosus*) is but little known; it differs from the preceding in the great length of its hair. It is found upon the Andes, at a considerable elevation.

The Eastern Tapir (*T. bicolor*) is a larger animal than either of the American species, measuring seven or eight feet in length. It is remarkable from its colouring,—the anterior portion and the legs being black, whilst all the hinder parts of the body are white. In its habits it appears to resemble the other species. It has only been found hitherto in Sumatra, Malacca, and Borneo; but from Chinese books and figures there is no doubt that it also exists abundantly in some parts of China. All the Tapirs, but especially the eastern species, are of a gentle disposition, and may be readily tamed; in confinement they appear to be very indiscriminate in their food.

Nearly allied to the Tapirs, and intermediate between these and the Swine, is a remarkable group of fossil animals, the remains of which are found abundantly in the gypsum beds of Paris. In the form of the skull they resembled the Tapirs, and as the nasal bones are strongly arched, they were doubtless furnished with a short proboscis. The structure of the incisor and canine teeth is also the same as in the Tapirs; but the molars were very different in form. All the feet had three toes, which were nearly equal in length. These animals form the genus *Palæotherium* of Cuvier; their size was sometimes small, but some of the species were as large as a horse.

The *Hippopotamidæ*, forming the third family of the Pachydermata, differ from the two preceding families in the form of the muzzle, which is exceedingly thick and blunt. The head is very large, but the greater part of its bulk is made up of the facial bones, which are of enormous size when compared with the cranium. The lower jaw is of immense size and power. Both jaws are armed with teeth of the three different sorts, and some of these attain a large size. The incisors are four in each jaw; they are of a cylindrical pointed form, the two middle ones are much longer than the others, and those of the lower jaw project forwards considerably. The canines are very large in the lower jaw; they are always worn away at the point by rubbing against one another. The molars are six or seven in number on each side, both above and below; they are of a quadrangular form, and exhibit at first numerous triangular tubercles, which, when worn down, leave peculiar isolated spots of enamel on the surface of the teeth.

The form of the body in the *Hippopotamus*, which is the only living species of this family, is peculiarly unwieldy, even amongst the Pachydermata; it is covered with a very thick naked skin, which only bears a few bristles upon the lips and at the tip of the very short tail. The legs are very short and stout, and the feet have four toes, each terminated by a hoof. The eyes and ears are small.

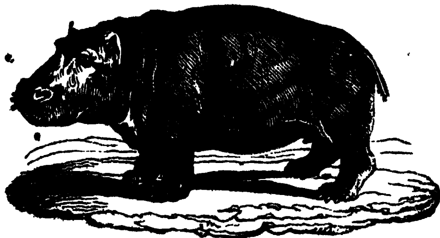


Fig. 329.—Hippopotamus (*H. amphibius*).

The only established species, the *Hippopotamus amphibius* (Fig. 329), is exclusively an inhabitant of Africa, in many of the rivers of which continent it is tolerably abundant. It is a large animal, the males, according to some travellers, attaining a length of fourteen or fifteen feet. It feeds entirely upon vegetable substances, cropping the herbage and bushes on the banks of the rivers, and occasionally visiting the cultivated grounds during the night, when it does great damage. It passes most of its time in the water, where it swims and dives with great ease, and is

said even to walk at the bottom of the water. On shore, they trot heavily but with considerable rapidity, and when two of them meet on solid ground they frequently fight ferociously, rearing up on their hind feet, and biting one another with great fury, so that, according to African travellers, it is rare to find a Hippopotamus which has not some of his teeth broken, or the scars of wounds upon his body. When not irritated, they appear to be quiet and inoffensive; but a very trifling irritation is sufficient to rouse their anger, when they attack the offender most furiously with their teeth; and a Hippopotamus which had been touched accidentally by a boat, has turned upon it and torn out several of the planks, so that it was with difficulty the crew got to shore. A Hippopotamus has also been known to kill some cattle which were tied up near his haunts, apparently without the slightest provocation.

The flesh of this unwieldy animal is said to be very good, and not unlike pork; it is in high esteem with the inhabitants of South Africa, both native and European. The feet, the tongue, and the tail are the favourite parts, and a thick layer of fat which covers the ribs is held in great esteem when salted and dried. It is called *Zeekoe-zpeck*; the name given to the Hippopotamus by the Dutch colonists being *Zeekoe*, or Sea-cow. The skin is cut into whips, which are highly prized, and the large canine teeth are sometimes used to furnish ivory. Two specimens of the Hippopotamus a male and female, are now living in the gardens of the Zoological Society; the male was the first ever brought to Europe, at all events in modern times.

A second species of *Hippopotamus* (*H. senegalensis*), inhabiting the rivers of Western Africa has been described by some authors; but its distinctness from the old species still requires confirmation. The fossil remains of several species are found in different parts of the world, principally in Europe and Asia.

A fourth family is that of the *Rhinoceridæ*, including the different species of Rhinoceros, which are nearly as bulky and unwieldy as the Hippopotamus, and, like that animal, are covered with a naked skin. The skin, however, in these animals, has a much rougher exterior than in the preceding family, and in some cases is laid in large folds, which give the creatures a curiously shielded appearance. The head is elongated and triangular, and from the upper surface of the muzzle there springs a single or double horn, composed of a solid mass of horny fibres, supported upon a broad bony protuberance of the nose. These horns are of considerable size, measuring frequently two feet and a half in length, and sometimes much more. They are of an elongated conical form, and usually more or less curved backwards; but in the British Museum there are two horns which are evidently curved in the opposite direction, and probably belonged to a species of which nothing further is

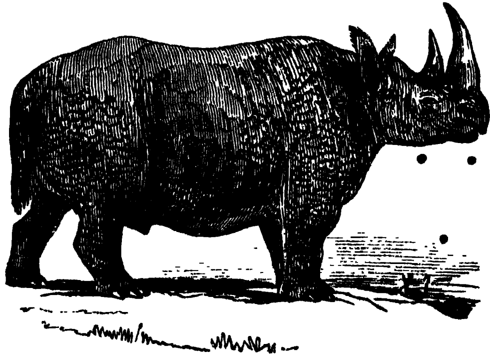


Fig. 330.—Two-horned Rhinoceros or Borélé (*Rhinoceros bicornis*).

at present known. The same collection contains another horn, which is more slender than usual, and curved backwards almost in a semicircle; all these have been described by Dr. Gray (*Proc. Zool. Soc.*). When two horns are present, they are placed one behind the other, and the hinder one is much shorter than the anterior. Only two sorts of teeth, incisors and molars, are found in the jaws, and of these the former sometimes fall out before the animal is full grown. The canines are entirely wanting. The molars are usually seven in number on each side of each jaw; their surface exhibits projecting lunate ridges. The body is very bulky, and is supported upon short, strong legs; the feet have three toes, which are only indicated externally by the hoofs.

These animals are found in the same regions of the Old World which are inhabited by the Elephants; they live like them in the forests, and feed upon herbage and the leafy twigs of trees and shrubs. They appear, as a general rule, to be peaceable animals, unless irritated; but in this case they charge with great fury upon their enemy, holding the head down, so as to present the point of the horn towards him. They are generally hunted merely for the sake of sport; but the natives of the countries inhabited by them kill them when they can, for the sake of the flesh; walking-sticks of great beauty are cut out of their thick hides, and their horns are worked into boxes and drinking-cups; to the latter of which the eastern nations attribute the power of indicating the presence of poison in any fluid that may be put into them.

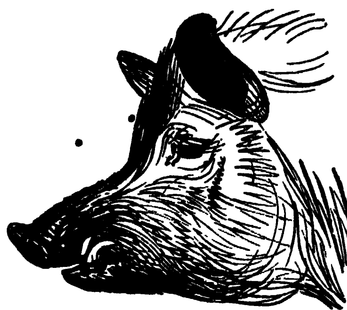
Little more than twenty years ago only four living species belonging to this family were known, but the number has since been increased to seven; and Dr. Gray has very recently described the horns of what appear to be two other species, distinct from any of those previously described.

Of the seven species, two have only a single horn upon the nose, and both these are natives of the East Indies and its islands. The best known is the Indian Rhinoceros (*R. unicornis*), which appears to be the species with which the ancients were best acquainted. It is a huge, unwieldy creature, measuring twelve or thirteen feet in length, and covered with an excessively thick skin, which lies in broad folds upon different parts of the body. This is also the case with a second eastern species, the Javanese Rhinoceros (*R. sondaicus*), which appears to be confined to the island of Java. In this species the surface of the skin is covered with numerous pentagonal shields, which constitute the epidermis.

Of the two-horned species, one (*R. Sumatranus*) is found only in Sumatra; it is distinguished from the other Indian species by the comparative smoothness of its surface. The remainder are all inhabitants of Africa, and principally of the southern extremity of that continent, where they occur in considerable abundance. The best known of these is the Borélé (*R. bicornis*, Fig. 330). The bones of several species of this family have also been found in a fossil state.

The division of the *Zygodactyla*, in which the feet are formed of two hoofed toes available for walking, and two others placed at some little elevation on the back of the foot, includes only a single family, that of the *Suidæ*, or Swine, of which the common Hog may be taken as an example. In these animals the nose, although possessing considerable power of motion, is not produced into a proboscis, nor is it swelled up into a blunt rounded mass as in the Hippopotamus, but runs in a tapering cylindrical form to the extremity, where it is suddenly truncated. The tip is of a firm cartilaginous nature, and is principally employed in turning up the earth in search of

roots and other articles of food. The skull is of a pyramidal form and the nasal bones are not elevated as in the Tapirs; but the facial bones are very large in comparison with the cranium. The jaws are always furnished with the three kinds of teeth whilst the animals are young, but the incisors are always small, and in some cases fall out with increase of age. The canines, on the contrary, are always of large size, especially in the males, in which they project from the sides of the mouth; those of the lower jaw, from constantly rubbing against their fellows in the upper, are usually sharpened to a most acute edge, and constitute formidable weapons. The molar teeth vary from three to seven on each side in both jaws. The feet consist of four toes, of which the two middle ones are considerably longer and stouter than their fellows, forming a cloven hoof, upon which the animals walk; the two lateral toes are also furnished with hoofs, but they are placed at the back of the foot at some little elevation from the ground. One of these hinder toes is wanting in some cases, whilst monstrosities have occurred with five toes, and others with a single hoof. The eyes are small, and the ears of moderate size and upright. The form of the body resembles that of our ordinary swine, but is lighter and less bulky in the wild species. The tail is rather short and slender; in most cases it is capable of being twisted up into a sort of curl upon the rump. The skin is covered with bristles.


Fig. 331.—Head of the Boar.

Unlike the Pachydermata of the preceding families, which only produce one or at the utmost two young at a birth, the Swine are very prolific, bringing forth frequently from eight to twelve young ones. The species are found in the warmer parts of both continents, only one, the Common Hog (*Sus scrofa*), being found wild in the temperate parts of the Old World. They live in the woods and forests, generally in marshy places, and feed partly upon roots and herbage and partly upon animal substances, such as insects and their larvæ, small mammalia, and even upon carrion. The females and young males live together in flocks, but the old boars are usually solitary, except during the rutting season, which they pass in company with the females; and at this period they have tremendous combats amongst themselves.

The best known species is the Common Hog (*Sus scrofa*), which is found wild in many parts of Europe, all over Asia, and in the north of Africa. It is also the original of our tame breeds, and from individuals of these which have escaped from captivity the American forests have been supplied with a numerous race of wild hogs. They feed at night, and often do immense damage to the crops cultivated in the neighbourhood of their abodes, rooting up all the produce in search of food. In the autumn they find a plentiful nourishment in the acorns and beech mast which fall from the trees. They are pursued with powerful dogs, and hunting the Wild Boar has always been a favourite sport in the countries where they abound. The flesh is superior to that of the domestic swine.

Domestication has produced an immense number of varieties in this Hog, but in all cases it is a most valuable animal. Its flesh is very good, and bears salting and drying remarkably well; it furnishes an abundance of fat, and both the leather made

from its skin, and the bristles which cover it, are applied to many important purposes. Add to this, that it is an animal easily kept, and that it thrives upon almost any description of food, and we shall easily see that few of our domestic animals are superior to it in importance. In this country, the Hog is rarely put to any use until after its death; but in Minorca, according to Pennant, he is employed as a beast of draught, and is often seen in that island working in company with the ass; and the same author tells us that he was informed by a Scotch minister that on his first going to his parish in Morayshire, he had seen a cow, a sow, and two young horses, "yoked together, and drawing a plough in a light sandy soil; and that the sow was the best drawer of the four."

Several other species of the genus *Sus* are found in a wild state in India and the Indian Islands. Some of the latter and the peninsula of Malacca are also inhabited by a singular species of Hog, called the Babyrussa (*Babyrussa alfurus*), in which the upper canines are of great length, turned completely upwards and curved backwards in a semicircle. The object of this peculiar structure of the tusks is entirely unknown; some of the older writers tell us that the Babyrussa hangs himself to the bough of a tree by means of these organs when he wishes to take a quiet nap; but the absurdity of this statement is very apparent. The Babyrussa is of a lighter form and furnished with more slender limbs than the other Hogs; it is of a mild disposition, and its flesh is very good.

Southern Africa possesses several large species of Hogs belonging to the genera *Phacochœrus* and *Potamochœrus*. The former are called Wart Hogs, from their having a large fleshy protuberance on each cheek; they are of moderate size, but furnished with most formidable tusks. The *Potamochœri*, instead of fleshy warts on the cheeks, are disfigured by a large bony ridge on each side. The head, in both of these genera, is large, and the animals have a most unprepossessing expression of countenance.

In South America this family is represented by the Peccaries (*Dicotyles*), in which the hind feet have only three toes, one of the hinder ones being deficient, and the tail is reduced to a mere rudiment. In form these animals resemble small Pigs, and they agree exactly in their habits with the Old World species. They are, however, far less prolific, only producing one or two young at a birth. On the back, concealed by the hair, the Peccaries have a peculiar gland which secretes a strongly odoriferous fluid; this is cut away by the Indians when they kill a Peccary, as otherwise the whole of the flesh would be contaminated. There are only two species, of which the commonest is the Collared Peccary (*Dicotyles torquatus*), which occurs in almost all parts of South America, and even extends into the southern parts of the United States. It furnishes an important article of food to the American Indians, and may be easily domesticated. In a wild state the Peccaries are usually seen in parties of eight or ten. They often swim across rivers, but as they are not active in the water they are easily killed in this situation by the Indians, who knock as many as they can on the head and pick up their bodies when there are no more to be killed.

In this section of the order we must also place the *Anoplotheridæ*, a family of fossil Mammalia, which constitute a most remarkable transition from the Pachydermata to the Ruminantia. They were of a more slender form than the other members of the present order, and were supported upon long slender legs, which were terminated by two distinctly separated toes, furnished with hoofs like those of the Ruminants. In addition to these, some species had a third small hoof at the back of the foot. The dentition in these animals was of a singular nature; they had six incisor teeth in

each jaw, on each side of which was a small canine tooth, and behind these seven molars on each side; and it is remarkable that the molars came close to the canine teeth without leaving any interval, an arrangement, which, in the living Mammalia, is peculiar to the human species. The Anoplotheridæ were furnished with a long tail; in some species, indeed, this organ was nearly as long as the body. They were of very variable size, and appear to have lived in society in marshy places, as their remains occur in situations which evidently possessed this character. They are found in the older tertiary strata.

In the *Lamnunguia* of Professor Wagner, with which we conclude the order Pachydermata, the feet are furnished with flattened nails instead of hoofs, and the animals composing the only family, that of the *Hyracidæ*, included in this section, are certainly very aberrant forms of the present order. They are of small size, and in many respects appear to approach the diminutive Rodentia; but it is generally admitted amongst zoologists, that their nearest alliance is to be found amongst the gigantic *Rhinoceridæ*. They are little Rabbit-like animals, entirely covered with hair, amongst which numerous bristles are scattered. Their legs are short; the anterior feet are composed of four toes, and the posterior of three, all furnished with flat hoof-like nails. The tail is entirely wanting. The incisor teeth are two in number in the upper, and four in the lower jaw; they are large and sharp, and as the canines are entirely deficient, the jaws present a superficial resemblance to those of the Rodentia, with which these animals were at one time arranged. The molars are seven in number on each side in both jaws; they closely resemble those of the Rhinoceros in form and structure.

The majority of the *Hyracidæ* are found in rocky districts in Africa; but one species, the *Hyrax syriacus*, is an inhabitant of Arabia and Syria. It is the *Shaphan* of the Hebrews, incorrectly translated *cony* in our version of the Bible. They run about with great activity upon the rocks, among the clefts of which they conceal themselves upon the least alarm. They feed upon herbage and the tender shoots of shrubs.

The Cape Hyrax (*Hyrax Capensis*), which is common at the Cape of Good Hope, is said also to extend up the east coast of Africa, as far as Abyssinia. It is called the *Dassie*, or Badger, by the Dutch boors at the Cape, and its flesh is sometimes eaten. It is the largest species, but measures only about eighteen inches in length. Another species, which also inhabits the Cape, is said to lodge in the holes of trees; it is from this called *Hyrax arboreus*; and Mr. Fraser has recently described a second arboreal species from the west coast of Africa under the name of *Hyrax dorsalis*. They are all very similar in their habits, and strongly resemble rabbits in this respect, frequently gambolling in small groups in the vicinity of their holes, whilst, according to some observers, an old male is set as a watchman, to give notice of the approach of danger, which he does with a shrill whistle. In the Jewish law, the Shaphan is said to chew the cud; and it seems not improbable, from the complex nature of the stomach, that it may, like the Kangaroo, possess the power of regurgitating its food into the mouth, to undergo a second mastication.

## Order V.—Solidungula.

**General Characters.**—This order has been established for the reception of the Horse and its allies, forming the single family of the *Equidæ*. Their most striking character consists in the structure of the feet, which are composed only of a single toe, inclosed at its extremity in an entire hoof. The structure of the leg bones is much the same as in the generality of the Mammalia, except that the humerus and femur

are comparatively short, and the bones of the fore-arm and shank, which are much longer, are partially anchylosed together, so that no rotatory motion of these bones can take place. The bones of the carpus and tarsus are large and solid, and resemble those of the other Mammalia in their general arrangement. Beyond these we find a single elongated metatarsal bone, the representative of the middle toe; the remainder of the metatarsal bones are either entirely deficient or represented by slender bones, called *splint bones;* but the whole weight of the animal is supported by the middle toe. This is completed by three phalanges, of which the last bears the single horny hoof.

The skull (Fig. 312) is of an elongated form, the jaws being much produced. and the lower one especially of great size and power. Both the jaws are furnished with six well-developed incisor teeth, small canines are also present in both jaws in the males, but in the females these teeth are usually quite deficient or rudimentary. The molars are six on each side in each jaw; their worn surface is flat, and exhibits a complicated pattern of enamel, generally in lunate forms. Between the molars and the canines there is always a great interval, and it is this space that receives the bit by which that powerful and valuable animal the Horse is subjected to the will of his human master.

The skin is clothed with hair, which is short on the general surface of the body, but usually attains a considerable length on the ridge of the neck, forming the flowing mane which adds so much to the beauty of the horse; the tail also, which is rather short, is furnished with a tuft of long hairs. The eye is rather large and full, and the external ears elongated, upright, and pointed.

All the species of the *Equidæ*, or Horses, are originally natives of the Old World. Two species, the Horse and the Ass, are well-known domestic animals, and have been under the dominion of man from time immemorial; they have been introduced into America by the Europeans, and immense numbers of horses, the progeny of individuals escaped from servitude, are now found wild upon the boundless plains of the western continent. In a wild state these animals, which are purely herbivorous, live together in large herds, usually led by an old male; they are exceedingly rapid in their movements, and when attacked defend themselves by kicking violently with their hind legs. The domesticated species exhibit a remarkable variation in size and colour, and all the species breed together with extraordinary facility.

The most important species belonging to this family, and perhaps the most important of all animals to man, is the Horse (*Equus caballus*). As a beast of burden and draught it is invaluable, whilst, unlike some other animals which are employed for the same purposes, and which are confined to particular regions, it thrives equally well in almost all parts of the world. The numerous changes induced in the different breeds by the circumstances of domestication, also add greatly to the universal value of the Horse; the swiftness of some varieties, the bulky strength of others, and the combination of these two qualities possessed by some of the most important breeds, adapting them to the most various requirements. Nor is this all, for, although in this country we do not eat horse-flesh, it forms an important article of diet amongst many nations even in Europe, and the milk of the mare is said to be a great luxury amongst the Tartars.

The native country of the Horse appears to be Central Asia, but this animal has been so long under the subjection of man that it is at present very doubtful what may have been the original extent of land inhabited by the species. At a very early period, as appears from the Book of Genesis, as well as from their monuments, the Egyptians

undoubtedly possessed numerous Horses; but whether these were indigenous to Egypt and the neighbouring countries, or whether they were imported from abroad, must be a matter of uncertainty. In the time of the Prophet Ezekiel, or nearly six hundred years before Christ, we find the horses of Togarmah, or Cappadocia, referred to; and it appears from various writers of antiquity that these were highly prized. Strabo, in particular, mentions that the Persians took an annual tribute of fifteen hundred horses from that province. Whatever may have been the original country of the Horse, however, there seems every reason to believe that most, if not all, of the so-called Wild Horses, even those which range over the vast steppes of Central Asia, are, like those of America, the descendants of individuals which have escaped from captivity; and it is certainly a hopeless task in the present day to attempt the discovery of the particular district first inhabited by this valuable animal.

The Arabian breed of Horses is one of the most celebrated in the World. It extends from South Western Asia and Upper Egypt along the whole north coast of Africa, and it is from these that all the finest races of European horses derive their best qualities. Of all the latter the English horses are undoubtedly the best, the great care bestowed in breeding them having produced a race of blood horses which excels even those boasted Arab steeds whose pedigrees have been sacredly kept for many generations. Our Horses, for ordinary purposes, have partaken of the same improvement as our hunters and race horses; coach and cart horses, with an infusion of high blood, being not only handsomer, but more serviceable than those of a lower breed. There are also several pure indigenous breeds of horses, which, however, are principally employed in draught, and often nearly confined to particular districts. The horses on the continent of Europe are greatly inferior to those of our own country, although several of the breeds have been imported into England, and have contributed in many cases to the formation of our different breeds. Amongst these we may mention the German, Flemish, and Holstein horses, the last mentioned of which are very showy, and are sometimes employed as coach horses. The true Spanish breed furnishes fine horses, descended from Arabs and Barbs.

The Ass (*Equus Asinus*), the second well-known species of this family, is found wild in the same parts of Asia as the horse, and it is here that we find it make the best figure in a domesticated condition. In these countries, indeed, the Ass appears to have been generally brought into a state of servitude at an earlier period than the Horse, and in the East, at the present day, Asses are far more commonly employed than horses, both for carrying burdens and for riding. The Ass in Arabia, Egypt, and Syria, and, indeed, in most oriental countries, is regarded as a valuable animal, and treated with care and kindness, and its appearance and spirit justify the attention bestowed upon it; but in Europe generally it is most shamefully neglected, treated severely, and very indifferently fed, so that it has naturally degenerated into the miserable, spiritless condition with which we are familiar, and which has led to its being almost entirely abandoned to the tender mercies of the lowest class of people. Nevertheless in some countries of the South of Europe the Ass still retains some of its original character, and there is no doubt that if a little care were bestowed upon the breed, it would soon be found to increase greatly in value. In the South of Europe, and in the East, Mules, or hybrids between the Horse and the Ass, are also very common, and are employed for many important purposes.

Some authors have described numerous species allied to the Ass as inhabitants of the great plains of central Asia; but of these the only one that seems to rest upon sure

grounds is the Djiggetai (*Equus Hemionus*). This animal is larger than the Ass, and of a pale grayish tawny colour, with a blackish-brown line down the back; it inhabits the eastern parts of Central Asia, and is said to be excessively swift in its course.

The remainder of the family *Equidæ* is composed of the Zebras, of which three species inhabit Southern Africa. These animals are nearly allied to the Ass and the Djiggetai, having the tail furnished with long hairs only at the tip, and the hind legs destitute of horny warts; these characters have induced Dr. Gray to separate the genus *Equus* into two genera, of which the Horse forms one, distinguished by its tail almost entirely covered with long hairs, and by the presence of horny warts on the inside of the hind legs below the hocks; whilst the remaining species constitute the genus *Asinus*. This division, however, has not been generally adopted.

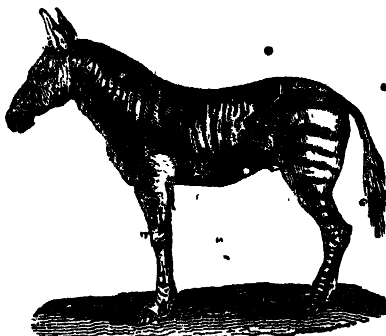


Fig. 332.—The Zebra (*Equus Zebra*).

The Zebras are all of a whitish or pale-brownish colour, elegantly adorned with broad black bands, which give them a most beautiful appearance. The handsomest species is the Hill Zebra (*Equus Zebra*, Fig. 332), an inhabitant of the rocky and mountainous districts of South Africa. It is distinguished from the other species by having the black bands on all parts of the body and limbs. The two other Zebras are the Quagga (*E. quagga*), and Burchell's Zebra (*E. Burchellii*); they both inhabit the plains, and are distinguished from the Zebra of the Hills by the absence of the black bands on the limbs. They all agree closely in their habits, living together in large herds, and scouring over the ground with great swiftness when threatened with danger. Their appearance in a state of nature is most beautiful, and they may be reclaimed sufficiently to be employed as beasts of draught; but domestication appears to deprive them of their spirit. Their flesh is eaten by the natives and hunters in South Africa, and is said to be exceedingly good, although coarse in its appearance.

## Order VI.—Ruminantia.

**General Characters.**—The Ruminants form the last order of the ungulated Mammalia and are especially distinguished from the animals of the preceding groups by the remarkable faculty of ruminating, or chewing their food twice over, which they all possess in an eminent degree.—Besides this character, however, they present several other important peculiarities in common, and in fact form one of the most distinctly circumscribed groups of Mammalia.

The head in the Ruminants is usually small in proportion to the size of the body; it is of an elongated, conical form, with the jaws of large size, but by no means so strong as in the preceding order. In the majority the lower jaw alone is furnished with incisor teeth, the only exceptions to this rule being the Camelidae. The number of incisor teeth in the lower jaw varies from six to eight, but when the latter number is present the two outer ones have been regarded by some zoologists as canines. The place of the incisors in the upper jaw is taken by a hardened gum, against which those of the

lower jaw press in the act of biting. The canine teeth are generally altogether absent in both jaws, unless we regard the two outer incisors as their representatives; and this view is supported by the fact that the Camelidae, which possess distinct canine teeth in both jaws, have only six incisor teeth in the lower. The little animals called Musk Deer possess canine teeth in the upper jaw and these in the males are of great length and project downwards beyond the lower jaw. Of the molars, which are separated from the front teeth by a considerable gap, there are always six on each side in each jaw. The three hindmost of these, or the true molars, are each composed of two columns, which in the upper jaw are convex internally, flat and furnished with three prominent ribs externally; in the lower jaw, on the contrary, the convex surface is external and the flat one turned towards the interior of the mouth. The teeth are completely surrounded with a thick layer of enamel, which is also folded inwards so as to form two semilunar figures in each column of the tooth; these are exposed as the teeth are worn away in grinding the food, and each tooth is then seen to consist of four crescentic folds of enamel, with their interstices filled up with dentine. The three foremost teeth in each jaw consist of a single column, and consequently present only two crescents of enamel.

In most Ruminants the frontal bone is furnished with a pair of appendages, or *horns*, which however differ greatly in their nature in the different families. In some the horns are permanent, consisting of a bony process of the frontal bone, which forms the core of the horn, and which is coated with a hollow cone, of a substance analogous to that of which the hoofs and nails of the Mammalia in general are composed; these are the true horns. In the Giraffe this horny coat is replaced by hairy skin similar to that of the body, and the horn is terminated by a tuft of hairs; these are also permanent. But the Stags, in which these weapons are almost always confined to the males, possess large branched bony *antlers*, which, notwithstanding their size, are produced every year a little before the season of their amours, and shed soon after this period of excitement has passed.

In the general arrangement of the skeleton, there is nothing to which we need refer here, with the exception of the structure of the feet, which is characteristic of the order. The peculiarity commences in the metatarsus, which is composed of a single elongated bone, the composition of which by the amalgamation of two of the true metatarsal bones is however always distinctly recognizable. At its lower extremity this bone exhibits two separate condyles, for the reception of the basal phalanges of the two complete toes, with which each foot terminates; these are followed by two others, so that each toe is composed of three phalanges, the last of which is inclosed in a complete hoof, and the extremity of the foot is deeply cleft. The animal consequently always walks upon two toes, but besides these, two others are often present at the back of the foot; these however are always but slightly developed, and furnished with very small hoofs, which are of considerable service to the animals in descending steep declivities. The structure of all the four feet is exactly similar, and the same conformation prevails throughout the order, with the exception of the Camels, which present as remarkable peculiarities in the structure of their feet, as in their dentition.

The Ruminantia are generally of moderate, or tolerably large size, and endowed with great swiftness of foot. They feed in herds, usually headed by an old male, and their diet consists exclusively of vegetable matter. As they naturally require a considerable quantity of this food for their support, and its proper mastication is a work of time, whilst, in a wild state they are constantly exposed to the attacks of carnivorous beasts,

from whose clutches they can only escape by flight, they would stand but a poor chance of obtaining a sufficiency of nourishment if the conformation of their intestinal canal were the same as that of the ordinary Mammalia, and we accordingly find that they have been furnished with a most remarkably complicated digestive apparatus, which enables them to take in as much food as they require by grazing for a comparatively short time, leaving the necessary comminution of the food, until they can retire to repose in a place of security. For this purpose the stomach is divided into four separate compartments, which are usually discribed as four distinct stomachs. The first of these, called the *paunch* (*rumen*) is by far the largest, and forms the receptacle into which the food is passed when first swallowed. The interior of this is covered with numerous villi. The second chamber communicates with the first by a rather wide opening; it is very much smaller than the paunch, and its inner surface is furnished with anastomosing ridges, forming numerous polygonal cells from which it has received the name of the *reticulum*. The third cavity is called the *psalterium*; it is also of small size, and its lining membrane forms several longitudinal plates, which have been compared to the leaves of a book, whence the name applied to it. The *psalterium* leads immediately into the *abomasus*, or fourth stomach, which is generally regarded as the analogue of the true stomach of those Mammalia in which that organ forms a single cavity; this is an elongated pyriform sac, which exhibits numerous folds upon its inner surface, and leads by its smaller end to the commencement of the intestine.

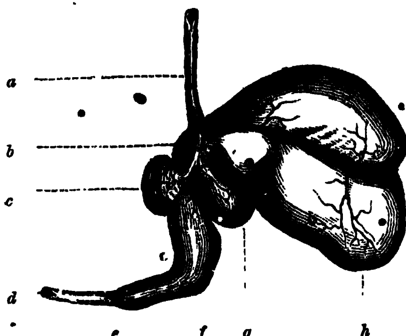



Fig. 333.—Stomach of the Sheep. *a*, œsophagus; *b*, cardia; *c*, psalterium; *d*, intestine; *e*, pylorus; *f*, abomasus; *g*, reticulum; *h*, paunch.

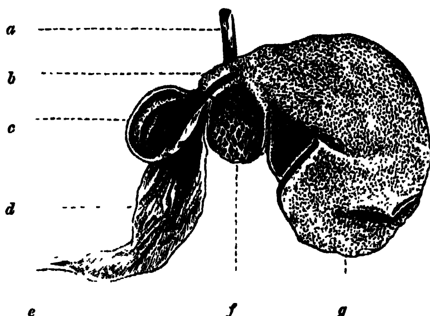



Fig. 334.—Section of the Stomach of the Sheep. *a*, œsophagus; *b*, groove; *c*, psalterium; *d*, abomasus; *e*, intestine; *f*, reticulum; *g*, paunch.

The mode in which this complicated organ is employed in the digestion of food is as follows:—The œsophagus leads down to an open canal, which communicates with the two first stomachs, and allows the crude vegetable matters to pass directly into the paunch. Here the food appears to undergo little alteration, beyond moistening with a saliva-like fluid; but when rumination is about to commence, a small portion of it is passed into the reticulum, where it is formed into a ball. From this it is expelled again into the canal of the œsophagus, by the action of the muscles of which it is carried up into the mouth, there to undergo the process of mastication. When suffi-

ciently comminuted, the portion of food again passes down the œsophagus; but this time the sides of the canal are closed by muscular action, so that the food cannot pass back into the paunch; and as the tube thus formed leads directly into the third cavity, the prepared aliment is necessarily conducted there. In this it undergoes a further change, previous to its admission into the fourth or true stomach, where the actual process of digestion is carried on. In the young Ruminants, this structure of the stomach is not distinctly visible, the first three cavities being very small, and the milk passes directly into the fourth or true stomach; and in the *Camelidæ* it has been recently found that the *psalterium*, or third stomach, is entirely deficient. This is also the case in the Javanese Musk Deer. In the Camels, however, the walls of the second stomach (*reticulum*) are excavated into large deep cells, which can be closed by muscular action; in these, those extraordinary quadrupeds are said to store up a considerable supply of water, which serves them for days when travelling over the parched deserts of Arabia and Africa.

In their forms the Ruminants are generally light and elegant, and supported upon long and rather slender limbs. Their skin is covered with hair or wool; their eyes are large, full, and often exceedingly beautiful; and their external ears are elongated, erect, and usually more or less pointed. The tail varies greatly in length and clothing, and the mammary organs are always placed between the posterior limbs.

**Divisions.**—The Camels, as already stated, differ remarkably in many respects from the other members of this order. In some of their characters they present a certain resemblance to the Horses, and they accordingly form the types of the first family of the Ruminants,—that of the *Camelidæ*,—which includes the Camels of the eastern, and the Llamas of the western hemisphere. In their dentition these animals differ greatly from the rest of the order. They have two canine teeth in each jaw, and the upper jaw contains two small incisor teeth, which, however, are placed close to the canines, so as to leave a considerable vacant space in the front of the mouth. The number of molar teeth varies, but there is usually one more on each side in the upper than in the lower jaw; in the true Camels the foremost molar is placed considerably in advance of its fellows, and is of a conical form, closely resembling the true canine.

The structure of the foot is very peculiar, the whole of the phalanges being turned forward in such a manner as to form an elongated foot (Fig. 311), the lower surface of which is applied to the ground; these two toes are merely enclosed in skin, and the hoofs, which are of very small size, appear more like nails than anything else. The hinder toes, which usually occur in the Ruminants, are entirely wanting.

The true Camels of the Old World, forming the genus *Camelus*, differ from the Llamas of America in several important characters, but in none more than in the construction of the feet. In the former the toes are united beneath by a pad-like sole, whilst in the latter they are quite separate. The eastern camels are also furnished with one or two large humps on the back, of which the American species are destitute. Of the true Camels there are two species,—the Arabian Camel, or Dromedary, as it is commonly called (*Camelus dromedarius*), which has a single hump; and the Bactrian Camel (*C. bactrianus*), which possesses two of these excrescences. The humps on the back of the Camel are not produced by any distortion of the spine, or prolongation of the spinous processes; they consist principally of fat, and appear to be intended as a supply of nourishment for the animal when exposed to privation of food, as their size has been observed to diminish greatly under such circumstances.

The native country of the Camels is in the warmer parts of Asia and Africa, but here they are not to be met with in a wild state; and the whole race appears to have been from time immemorial under the dominion of man. Their immense strength, their patient and quiet disposition, and the amount of hardship and privation which they are able to bear, certainly give them a high place amongst domestic animals; and indeed it is difficult to conceive how the affairs of mankind could have been carried on in the regions inhabited by the Camels without their assistance. The inhabited parts of these countries are separated from each other by wide tracts of desert, frequently almost entirely destitute of herbage, or at all events of any that a Horse would deign to eat; in many cases the sandy ground would yield under the Horse's hoofs, so that he would be tired out before half his day's journey was done, and all the while he would be exposed to the parching rays of the sun, whilst a chance of obtaining water would probably occur not more than once in three or four days. To a certain extent these eastern countries are as effectually separated from each other as if the sea rolled its waves between them, in either case some special means of passing over the interval is required. This is afforded by the Camel. The desert is his home; he can feed upon the scanty vegetation that springs up here and there upon the arid wastes; his foot is specially adapted for the sandy ground, over which he can pass without tiring, for hours together, with a load of five or six hundredweights upon his back; and lastly, by a singular provision of nature, he can journey on beneath the burning sun without drinking for several days. It is no great wonder that the Arabs, in their poetical way, should have given the name of the "Ship of the Desert" to this valuable creature.

With regard to the power of the Camel to support thirst, there has generally prevailed some little exaggeration. It has been stated that this animal will bear deprivation of water for a period of no less than fifteen days; but Burckhardt states that the time varies greatly according to the breed and the country in which the Camels have been accustomed to travel. Thus the Egyptian and Syrian Camels require frequent draughts during the summer months, whilst those which journey in the Arabian deserts will go for four days without drinking. The same author says that some of the African caravans travel for a much longer time without water; but he considers nine or ten days to be the utmost, and even then a good many Camels die on the road. The means by which the creature supports this long deprivation of moisture is said to be by storing up in the cells of the paunch and honeycomb stomach a sufficient supply of moisture to last for several days' consumption. This has been disputed by some zoologists, from their finding no water in these cells on dissecting Camels; and Burckhardt states that no great quantity of fluid is found in the stomachs of these animals, unless they have been drinking not long before. These reasons cannot, however, be considered as conclusive, unless we knew the precise conditions under which the animals had been living. There seems, however, to be little doubt that there is no truth in the popular belief that, when in great want of water, the Arabs kill a Camel for the sake of the supply contained in its stomach, for Burckhardt never saw this plan put in practice, nor could he ever hear from the Arabs of their making use of any such method of supplying their necessities, although they frequently entertained him with accounts of the hardships they underwent in the deserts from this very cause.

For the purpose of loading and unloading, the Camels are made to kneel down, and those parts of their bodies and limbs which come in contact with the ground acquire

remarkable callosities in course of time. The most considerable of these is situated on the breast. They repose in the same position; and to keep them from straying during the night, their drivers tie the fore legs in a kneeling position, so that they cannot rise beyond their knees. When overloaded it is said that they obstinately refuse to rise, even when they are beaten most severely; and it appears that the drivers are by no means averse to exercising their authority in this way, the poor creatures being often most inhumanly treated. The load of a Camel varies considerably, according to the distance he has to go and the hardships he will have to endure. Large powerful Camels will carry a weight of fifteen hundred pounds for three or four miles, and these will travel for several days with a load of a thousand pounds. Those coming to Egypt from the interior of Africa rarely carry more than five hundredweights. With such loads as these they will travel about thirty miles a-day.

But it is not merely as a beast of burden that the Camel is of value to the natives of eastern countries; in travelling to any distance their journeys are usually performed on the back of one of these animals. The riding Camels are, however, of a different breed from those employed in transporting merchandize, and a good one is as highly prized amongst the Arabs as a fine Horse in England. Some idea of their speed and endurance may be obtained from the fact, related by Burckhardt, that an Egyptian Camel travelled a hundred and fifteen miles in eleven hours, besides being carried twice over the Nile, a process which occupied about twenty minutes each time.

These, however, are not all the benefits derived by man from the Camel. His flesh is eaten, and the hump on his back is esteemed a great delicacy. The milk of the female is also said to be very good. The hair, which is long and soft, falls off in large flakes during the rutting season; it is woven into a sort of cloth, which is said to be impervious to wet. The female goes with young about a twelvemonth.

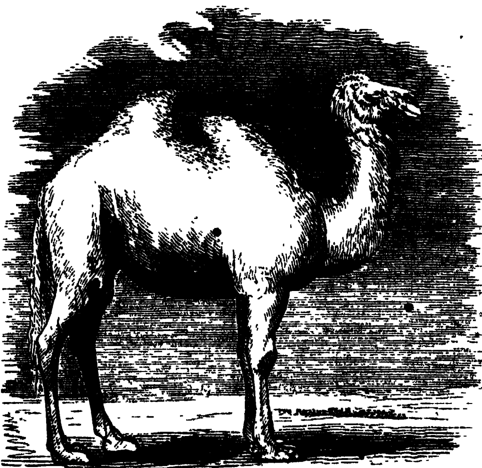


Fig. 335.—Bactrian Camel (*Camelus Bactrianus*).

The Camels are amongst the largest of the Ruminants, some of them measuring as much as seven feet in height and upwards of ten feet in length. Their form is by no means elegant, the dorsal humps giving them a deformed appearance, which is not lessened by their long and peculiarly curved necks and clumsy legs and feet. The two species are very similar in all their habits, but their geographical range is very distinct.

The Arabian Camel is distributed over the south-western parts of Asia and the north of Africa, as far as the shores of the Niger and Senegal. It has been introduced into Italy, where it breeds, although very sparingly. The male of this species is said,

when irritated, to protrude a large inflated organ from the throat; but the nature of this organ is unknown.

The country of the Bactrian Camel, which is rather larger than the Arabian species, lies to the north-east of the regions occupied by the latter; it is dispersed over the whole of Central Asia as far as China, and has also been introduced into India. In Bucharia, Cabul, and some parts of Persia, the two species occur together; and in some other Asiatic provinces it is the practice to cross them. The Bactrian Camel extends westwards to the country lying between the Caspian and the Black Sea, and it is also abundant in the Crimea. In Asia it extends as far north as the sixtieth degree of latitude, but beyond this point the winters are too severe for it. In some districts this animal is employed as a beast of draught, but this practice is by no means general. It appears to be far more hardy in its nature than the Arabian Camel, and lives frequently in hilly districts; its feet are better adapted for walking on hard surfaces.

The Llamas (*Auchenia*), which represent the Camels in the New World, are readily distinguished from the true Camels by the absence of dorsal humps and the complete division of the toes (Fig. 336). This structure of the feet does not adapt them for travelling over such sandy wastes as form the natural home of the Camel, but for dwelling on mountains and amongst rocks, where their footing is more sure than that of most other animals. Their form is lighter and more elegant than that of the Camel; they are much smaller in size, and far inferior to their eastern relatives in strength. When irritated, they have a habit of ejecting the contents of their mouths, consisting of food undergoing its second mastication, upon the offending party; this is doubtless exceedingly disagreeable, but the popular belief in the venomous nature of the substance discharged is of course quite destitute of foundation. Their native region is upon the slopes of the immense chain of the Andes, in South America, on all parts of which they occur; and although inhabitants of tropical climates, they are very impatient of heat, and often ascend into the vicinity of the line of perpetual snow. The wild Llamas are very vigilant and shy; they live in flocks at a great altitude upon the mountains, and only descend toward the plains occasionally in search of food. Both the wild and the tame Llamas have the singular habit of always, when practicable, dropping their dung in the same place, so that considerable heaps of excrement are found in particular spots; the wild ones have also been observed to retire in the same way to a particular spot to die, and in some places it is said portions of the banks of rivers may be seen almost whitened with their bones.



Fig. 336.—Foot of the Llama.

Considerable doubts exist as to the number of distinct species of Llamas. There appear to be four species, but some zoologists reduce them to two, considering the others as domesticated varieties of these. Some writers, on the contrary, increase the number to five or even six. The principal species or varieties are certainly four in number.

Of these the Guanaco (*Auchenia Guanaco*) is supposed by many to be the wild stock from which the true Llama is derived. This animal is found on all parts of the Andes, from the Straits of Magellan to the north of Peru; in the southern districts the Guanacos live together in considerable herds upon the desert plains of Patagonia; but in Peru they inhabit the mountains, and are rarely seen to collect in greater numbers than seven. They stand rather more than three feet high at the shoulder, and the neck, which is often carried upright, bears the head at a height of nearly five feet from the ground. They are of a pale reddish-brown colour, and covered with long hair, which, however, is not so long as that of the domesticated Llama. When taken young, they may be tamed, but always retain a tendency to return to the wild state; they are also bolder than the ordinary domestic Llama, and will attack strangers by striking at them with their knees. They are principally sought after for the sake of their skin and flesh.

In every respect, however, the Guanaco is a far less important animal than the true Llama (*A. glama*), which completely takes the place of the Camel amongst the Indians of Peru and Chili. It is of about the same size as the Guanaco, of which it may possibly be only a variety, as the principal differences between them are such as might well be produced by domestication, namely, a stouter and heavier form and a variable colour, generally brown with white patches or spots. The immense value of the Llama to the aborigines of the countries which it inhabits will be easily understood from the fact, that at the time of their discovery by Europeans it was the only domestic animal that they possessed. When alive it is employed as a beast of burden; and although it is unable to bear a great weight (ninety or a hundred pounds being about the heaviest load that it can carry), its power of travelling over rugged declivities where no other loaded animals could maintain their footing, have rendered its services indispensable in those countries even to the present day, although its place has been to a certain extent taken by mules. It is, however, slow in its march, rarely travelling more than ten or twelve miles a-day. When killed, its flesh furnishes a wholesome and excellent food, and the long woolly hair with which it is covered forms the principal clothing of the Indians. The keeping of a herd of Llamas is a matter of little or no difficulty; at night they are put into an inclosure, where they sleep winter and summer without any protection, although at the elevation which they usually inhabit the temperature often falls below the freezing-point immediately after sunset even in the summer. In the morning they are allowed to quit the inclosure, to wander about upon the mountains in search of food; and they return of their own accord in the evening, to be again shut up for their night's rest. The dung, like that of the Camel, is employed as fuel; the milk is said to be pretty good, and the skin furnishes a good leather.

The Paco, or Alpaca (*A. Paco*), which is also domesticated by the Peruvians, is considerably smaller than the Llama, and is never employed as a beast of burden; is is principally valued for the sake of its long, soft, silky hair, which is woven into fabrics of great beauty. Great quantities of this have been imported into this country of late years, and the stuffs made from it are well known.

The fourth species is the Vicugna (*A. vicunia*), which is about the same size as the Alpaca; its colour is reddish-yellow on the back and whitish on the belly. It is a wild species, which is principally sought after for the sake of its fine wool, stuffs woven from which are considered rather valuable amongst the native Peruvians.

In all the other families of the Ruminants, the feet touch the ground only at the extremities of the two principal toes, which are inclosed in horny hoofs; and there are almost always two rudimentary toes, with small hoofs, at the back of the foot. The upper incisor teeth are entirely wanting, as are also the canines in both jaws, except in a few Stags and the family of the *Moschidæ*, or Musk Deer, in which the canines are developed in the upper jaw, and acquire such a size in the males as to project beyond the lower jaw in the form of tusks. The Musk Deer differ from the members of the remaining families of the Ruminants in the total absence of horns in both sexes; the lachrymal sinuses are also deficient. In their general structure they resemble the *Cervidæ*, or Stags, which constitute the following family. They are all of small size, supported upon exceedingly slender legs, and very active in their movements. They live in flocks, principally on the continent of Asia, and in some of the larger islands of the Indian Ocean, such as Ceylon, Java, Sumatra, and Borneo. One species, the *Moschus aquaticus*, is an inhabitant of Sierra Leone, on the west coast of Africa.

The true Musk Deer (*M. moschiferus*) is distributed over the mountainous parts of central Asia, and is said even to extend into Siberia. The male of this species is furnished with a remarkable sac beneath the belly, which secretes a strongly odorous substance, the well known powerful perfume and valuable medicine called *musk*. It is from this that the genus takes its name. It is an excessively active creature, performing leaps which are perfectly astonishing; when the snow is on the ground it is said to extend its hoofs, and run without leaving any traces upon a surface which will not even bear the weight of a dog.

This is the only species which inhabits a temperate climate; the others are confined to the tropical parts of Asia. They are destitute of the secreting organ which produces the musk, but their flesh is said to be very good. One species, the Kanchil (*Tragulus kanchil*), is exceedingly common in the peninsula of Malacca, in Java, and some of the neighbouring islands, the natives of which often capture numerous specimens either in traps or by throwing sticks at their legs when they come at night to feed in the fields upon the sweet potatoes, of which this species is said to be very fond. In Java, according to Sir Stamford Raffles, the cunning of the Kanchil is so celebrated, that its name is often applied metaphorically to a distinguished rogue. When taken in a noose it will feign itself dead, until the unwary captor releases it, when it immediately springs upon its feet, and makes its escape.

The third family is that of the *Cervidæ*, or Deers, distinguished principally by the peculiar nature of the horns or antlers, which, with but a single exception, that of the Reindeer, are possessed only by the males. Unlike the horns of the Ox, the antlers of the Deer are deciduous,—that is to say, they are cast every year after the breeding season, and again renewed before that period of excitement returns. They are produced upon a pair of processes of the frontal bone, by an action analogous to that by which injuries to the bones are repaired. The process forming the base of the horn is covered by a skin, beneath which a sort of inflammation is set up; this produces cartilaginous matter, which increases rapidly in amount, gradually becomes ossified, and finally forms the horn, which, when mature, is still covered by the vascular skin beneath which it has been formed. This, however, dries up and peels off soon after the complete development of the organs, and the latter then consist of bare bone. The antlers are sometimes small, but generally of comparatively large size, and very variously branched; their size and the number of branches usually increases with age,

and the old males of several species are adorned with a most enormous pair of spreading horns.

Beneath each eye, in almost all the species, there is a cavity called the lachrymal sinus, which the animal is able to open at pleasure, and which secretes a thick waxy fluid ot a disagreeable odour. The metatarsus is also usually furnished with one or two glands, covered with a small tuft of hair; the presence of these furnishes a good character for distinguishing the hornless females of this family from those of such Antelopes as are also destitute of horns. They are deficient only in the Muntjacs,—a small group of oriental Deer forming the genus *Stylocerus*.



Fig. 337.—The Stag, or Red Deer (*Cervus elaphus*).

The species of Cervidæ are very numerous, and distributed in all parts of the world. By some zoologists they are considered as forming only a single genus, whilst others divide them into several generic groups, characterized principally by differences in the conformation of the antlers.

Of these groups the Muntjacs (*Stylocerus*) appear to possess the best title to generic distinction. They evidently form a transition from the typical Cervidæ to the Moschidæ, as they possess large canine teeth in the upper jaw, are destitute of the glands and pencils of hair on the metatarsi, and have the antlers of very small size. The structure of the latter is very peculiar; the processes of the frontal bone, on which the horns are supported, instead of forming a mere knob, as in the ordinary Deer, are produced into elongated stalks, so that the animals after the shedding of their true antlers, still appear to be furnished with straight horns. The species, which are not numerous, are of small size, and very elegant in their forms.

They are inhabitants of India, China, and some of the islands of the Eastern Archipelago, where they frequent mountain valleys, generally in the neighbourhood of forests and jungles. They are hunted both by the natives and European residents, usually with dogs, upon which they frequently inflict severe wounds with their tusk-like canines.

In the typical Stags, forming the genus *Cervus*, the antlers are large, rounded, and much branched. As an example of this group, we may mention the Red Deer of these Islands (*Cervus elaphus*, Fig. 337), which is distributed over most parts of Europe and the north of Asia, but is now becoming rare in the more inhabited countries. In

England the Red Deer is very uncommon, but in the Highlands of Scotland it occurs in greater abundance, and its pursuit is still a favourite sport, with those privileged persons whose position enables them to follow it. In olden times, hunting the Stag was regarded as the noblest of all sports; it was reduced to a science, encumbered with an infinity of bewildering terms, the knowledge of which however, was considered indispensable for a finished gentleman.

The Stag is the largest of the British species, standing about four feet high at the shoulders. It is of a reddish brown colour, whence the name of Red Deer, commonly applied to it; the antlers are variable in the form and arrangement of the branches; they attain a considerable size, sometimes weighing as much as twenty four pounds. The time occupied in the development of this mass of bony matter, is rarely more than ten weeks.

The Stag lives in forests, principally in mountainous districts, and associates in herds usually consisting of a single sex. It feeds on almost all kinds of vegetable matter.

In North America, the Red Deer is represented by the Wapiti (*C. canadensis*), a species of larger size, measuring nearly five feet at the shoulder. It is found only in Canada, and the most northern parts of the United States, where it is hunted by the Indians, principally for the sake of the skin, which is said to retain its flexibility after being wet. The antlers are a good deal larger than those of the Stag. Several other species of this genus are found in different parts of America, and in the East Indies, some larger, but the majority smaller than our common Stag. Amongst the Indian species, we may mention the species of Axis or Hog Deer, ( *Cervus Axis* [Fig. 338] and *porcinus*), which are about the size of our Fallow deer, and of a darker or lighter brown tint, spotted with white. They inhabit the plains and valleys of India, and their pursuit constitutes one of the most favourite sports in the East. Their antlers are rather small, and furnished with but few branches.



Fig. 338.—Axis Deer. (*Cervus Axis*).

The males of many species possess a most disagreeable odour, which is sometimes perceptible even at a distance. This is remarkably the case in a South American species called the Guazuti (*Cervus campestris*), the offensive smell from which was perceived by Mr. Darwin, when passing at half a mile to leeward of a herd. So strong is this odour that the skins, when dried and prepared, still retain it; and a silk handkerchief in which Mr. Darwin carried home

a skin, retained the smell for a year and a half, although repeatedly washed in the interval.

A second British species is the Roe (*Capreolus Capræa*), which forms the type of a distinct genus. It is a small animal, measuring a little more than two feet at the shoulder, and two feet and a half at the hind quarters. The antlers are small and furnished only with three short branches. The Roe is an inhabitant of mountainous districts, where it exhibits the most extraordinary agility, and Mr. Tytler in a letter to Professor Bell, says that he has seen one without much apparent effort, bound across a road nearly twenty feet wide. Unlike the Stag, which is polygamous, the Roe is said to pair, and remain faithful to one partner for life. The female often produces two young at a birth, which are treated with great affection by both parents; and according to many writers, these young animals, after quitting their parents become attached to each other and remain together.

In some South American species, the Brocket Deer, forming the genus *Coassus*, the horns are quite simple, presenting a good deal of resemblance to those of some Antelopes, but are destitute of the horny covering which is characteristic of those animals. They are of small size, only measuring about two feet in height at the shoulder.

In the remainder of the family the antlers are always more or less palmated or dilated into broad plates of bone. To this series belongs the third British species, the Fallow Deer (*Platyceros Dama*), which forms the type of a distinct genus, distinguished by its naked nose. It is doubtful whether this elegant animal is really a native of Britain, as it is never found wild in this country, but always in a semi-domesticated state, as an ornamental animal in parks. Its native country is the south of Europe and the south-western parts of Asia, from which it was probably introduced into England at an early period. It is about three feet in height, and of a reddish-brown colour spotted with white; but there is a variety which is of a nearly uniform dark brown. The horns are large, and terminated by a long palmate portion, which is deeply and irregularly notched on the outer margin. The flesh of this ianimal, which is well-known as *venison*, is regarded as a great delicacy. and is far superior to that of either of the British species. The skin furnishes a soft leather, which was formerly in great request for breeches.

Nearly allied to the Fallow Deer was the gigantic extinct species commonly known as the Irish Elk, the bones of which have been discovered in considerable numbers imbedded in peat bogs in Ireland. This animal stood six feet or more in height, and the antlers were of enormous size, some specimens measuring upwards of thirteen feet from tip to tip.

The Elk, or Morse Deer (*Alces palmatus*), is a large species, which is common to the northern parts of both hemispheres. The nose is entirely covered with hair, and the antlers, which are comparatively short, are very broadly dilated, and terminated by a numerous series of long points. When fully developed, these organs weigh from fifty to sixty pounds. It is the largest of the recent species of this family, standing upwards of six feet in height at the shoulder; its legs are very long, its neck thick and short, and its head elongated and terminated by a broad muzzle, so that its appearance is more ungainly than that of the other Cervidæ. It lives in damp forests, where it feeds for the most part on the tender twigs of trees. Its flesh is highly esteemed as an article of food, and the skin, which is soft and thick, furnishes a most excellent leather.

The most celebrated species of this family is the Rein Deer (*Rangifer Tarandus*, Fig. 339), the only species which has been completely domesticated, and without which the inhabitants of Lapland and some other countries of the extreme north would be unable to exist in those inclement regions. The Rein Deer is, in fact, as necessary to the Laplander as the Camel to the Arab of the Desert; its flesh is his principal food, its skin furnishes his clothing, its milk stands him instead of that which the Cow yields to the natives of more genial climates, whilst it is capable of being trained as a beast of draught, and, when harnessed to a sledge, will with ease perform a journey of eighty miles in a day over the frozen snow. To adapt it for travelling over this peculiar surface, the hoofs of the Rein Deer are broad and very deeply cleft, so that by their separation they press upon a large extent of snow; and the hinder toes hang down so as nearly to touch the ground, and doubtless contribute greatly to support the animal in passing over a yielding surface. The harness by which the Rein Deer is attached to the sledge is of the simplest nature; a collar of skin passes round the neck, from which a single trace runs back to the sledge, passing between the legs of the animal; the rein is also single, and is attached to the neck; and the driver directs his cattle simply by shaking the rein, or throwing it from one side of the back to the other.

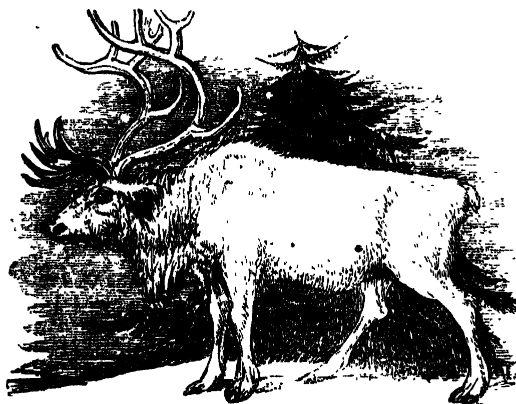


Fig. 339.—The Rein Deer (*Rangifer Tarandus*).

The wealth of a Laplander is computed from the number of his Rein Deer. Some of them possess herds of more than a thousand of these animals. In the summer the Rein Deers are pastured in the mountains, where they feed upon ordinary herbage; at the approach of winter they are driven down into the plains, and their food at this season consists principally of a particular species of lichen (*Cenomyce rangiferina*), which they dig up from beneath the snow by means of their hoofs. When going on a journey, the Laplanders take a supply of this lichen with them, and four pounds of it are said to be sufficient for a day's journey; in some cases, however, the animals will travel for two or three days without food, and without apparently feeling the want of it.

In their habits the wild Rein Deers resemble their domesticated brethren, and like them they seek their food in different localities, according to the season of the year, performing extensive migrations in the spring and autumn with this view. It is during these migrations that they are generally killed by the hunters; and the autumn is the period generally chosen, as the animals are then in the best condition, and their flesh may be prepared for winter use. For this purpose the flesh is sometimes salted, but more commonly either dried in the air or smoked; in some places it is buried in the frozen soil, and preserved in this condition.

The Rein Deer varies considerably in size in different places. It is usually however about three feet in height at the shoulder, and nearly five feet in length. Both sexes, as already stated, are furnished with antlers, which are smaller in the female than in the male. The colour of the wild Rein Deer is usually grayish, but that of the domesticated individuals is very variable. They usually acquire a whitish tint in the winter.

The Rein Deer is now distributed principally in the extreme northern parts of both continents. It also occurs on the Islands of Spitzbergen, and Nova Zembla. It extends southwards in certain places as far as the fiftieth degree of North latitude.

The fourth family, that of the *Camelopardidæ*, includes only a single living species, the Camelopard or Giraffe (*Camelopardalis Giraffa*, Fig. 310), which is peculiar to Africa. This remarkable animal is distinguished from all the other Ruminants, by several important characters. The body is short and supported upon very long legs; the dorsal line slopes downwards towards the rump, the withers being greatly elevated, and from this it was long confidently asserted that the fore legs were much longer than the hinder pair, although this is not the case. The neck is excessively long, and furnished with a short mane, running down its dorsal line; the head is comparatively small and the countenance exceedingly gentle and pleasing in its expression, the eyes being remarkably full and lustrous. The dentition is the same as that of the Deer, the upper incisors and the canines in both jaws, being quite deficient. The forehead bears a pair of tapering cylindrical bony appendages, which are covered with a hairy skin like the rest of the head. These are permanent, and might be regarded as the representatives of the processes of the frontal bone, upon which the deciduous antlers of the Deer are developed, but they are distinct bones, only united by those of the skull, by a suture, and instead of rising exclusively from the frontal bones, their broad base covers the coronal suture, so that they rest partly upon the frontal, and partly on the parietal bones. In front of the horns, the frontal and nasal bones are elevated to form a rounded protuberance which has been described as a third horn by many writers. The feet are destitute of the accessory hoofs which occur in most of the other Ruminants except the Camelidæ; and the tail is rather long, and terminated by a tuft of very long and thick hairs.

The Giraffe is the largest of all Ruminants; the males not uncommonly measuring fifteen or sixteen feet from the top of the head to the ground, whilst Sir W. C. Harris met with one that measured eighteen feet. The females are usually a foot or two shorter. The height at the withers is usually about ten feet in large animals, whilst the length of the body from the breast to the rump is not more than six or seven. The ground colour of the skin is yellowish, but it is covered with large spots and patches of lighter and darker brown, which give it a very elegant appearance.

The Giraffe is a native of the eastern parts of Africa, from the Cape northwards as far as Nubia. It lives in small herds upon the plains, always in the neighbourhood of woods, as it feeds almost entirely upon the tender shoots and leaves of trees, which the great length of its neck enables it to reach with ease. The tongue also is very extensible, and is employed as a prehensile organ, and the large free lips can be used in the same way.

The Giraffe is not a very swift animal, and when pursued its gallop is described as exceedingly ludicrous, the hind legs being brought forward at each step completely in advance of the anterior ones, apparently a foot or two on the outside of them; in this

fashion the Giraffes contrive to get over the ground pretty rapidly with a curious springing motion. They are easily overtaken by a pretty good horse, and the rider may then select his victim from the herd, cut it off from its companions, and shoot it at his leisure.

When going at full speed the heels of the Giraffe constantly throw up dirt, sticks, and stones in the faces of its nearest pursuers, but it never appears to attempt



Fig. 340.—The Giraffe. (*Camelopardis Giraffa*).

to defend itself unless brought to bay; in this case its weapons are its hoofs, with which it kicks out so rapidly and vigorously that dogs will not venture to attack it, and it is even said by Le Vaillant, that it can beat off the Lion in the same manner.

The flesh of these animals, when young is considered very good; that of the old Giraffe is coarse. The skin is very thick and highly valued by the natives of South Africa, who consider the leather formed from it to be the best material for sandal

soles. They also use the skin in the formation of vessels to hold water, and sometimes as a covering for their huts.

Several Giraffes have lived for some years in the Zoological Gardens in the Regent's Park. They have even bred several times in that establishment, and the young animals have thriven admirably. The female goes with young about fourteen months, and produces a single young one at a birth; this when born measures nearly six feet in length from the head to the root of the tail.

A single fossil species of this family is known to us by its remains, which have been found in the tertiary strata of the Sivalik Hills, in India. This is the *Sivatherium*, the head of which exceeded that of the Elephant in size.

The fifth and last family of this order is the family of the *Bovidæ*, including the numerous species of Antelopes, and the Cattle and Sheep. In these animals, the horns consist of a conical process of the frontal bone, which is covered by a sheath of horny matter; hence the name of *Cavicornia*, or Hollow-horned Ruminants, often applied to this group. The horns are permanent, and present with but few exceptions in both sexes. They vary greatly in bulk, length, form, and direction in the different subordinate groups. The dentition is the same as that of the stags, and the feet are furnished with accessory hoofs. These animals are all strictly herbivorous, usually feeding upon the different kinds of grasses; they live together in more or less numerous flocks, and are distributed over both Hemispheres.

We may distinguish three principal forms amongst the animals composing this family, although it must be confessed that these pass very gradually into each other. The first of these groups consists of the Antelopes, which are placed in a single genus by some authors, whilst others divide them into a great many groups. They are distinguished by their more or less cylindrical horns, of which the core is composed of solid bone; they are for the most part light, slender, deer-like animals, which generally possess an extraordinary degree of activity, but they gradually pass on the one hand to the Oxen, and on the other to the Sheep. The greater part of the species are found in the Old World, principally in Asia and Africa; the latter continent is indeed the head-quarters of the Antelopes, for out of sixty-nine species recorded by Professor Wagner, no less than fifty-four are inhabitants of Africa, and of these twenty-five occur, most of them exclusively, in the southern extremity of that continent.

They vary greatly in size; the Eland (*Boselaphus Oreas*) measuring upwards of six feet in height at the shoulder, whilst one of the smallest species (*Cephalolophus pygmæus*) is not more than a foot high. They live together, often in vast herds, principally upon the grassy plains, and some of the species appear to migrate in immense numbers from one part of the country to another.

One species, the Chamois (*Rupicapra Tragus*), is an inhabitant of the mountainous parts of Southern Europe, and in fact, is not positively known to occur any where else. It lives in small flocks, and bounds from rock to rock with wonderful agility. Both sexes are furnished with small recurved horns, and the hair is brown and harsh. The flesh is eaten, and that of young animals is considered a delicacy. The skin also furnishes an excellent leather, and the chamois is pursued with great ardour by many of the inhabitants of the countries where it occurs, but rather for the sake of the excitement of the chase, than for the value of the animal when obtained. This excitement must indeed be great, for notwithstanding the dangers and privations to which the hunters are exposed in pursuing these active creatures amongst

the highest precipices of the mountains, these men rarely give up the occupation; and De Saussure mentions a case in which three generations, father, son, and grandson, were all killed successively by accidents incurred in this pursuit. The Chamois evidently approaches closely to the sheep and goats, and this is still more distinctly the case with the so-called Rocky Mountain Sheep (*Haplocerus laniger*) of North America, a species closely allied to the European Chamois.

The only other Antelope found in Europe, is the Saiga (*Colus Saiga*), which occurs on the steppes of Russia, both in Europe and Asia. Its most westerly habitation is Poland. It is rather a large species, measuring rather more than two feet and a half in height, and is furnished with strong horns; it is said that individuals with three horns are occasionally met with. The structure of the nose is also very peculiar, the nasal bone being completely amalgamated with the frontal bone, and very short, thus leaving a very large nasal opening, which is covered with a tumid, muscular and cartilaginous arch.

Amongst the strictly Asiatic species, the Chiru (*Pantholops Hodgsonii*), a native of Thibet, and the plateaux of the Himalayas, is closely allied to the Saiga, with which it agrees in size; it is furnished with long annulated horns, and with a remarkable soft swelling on each side above the nostrils.

Another Indian species, the Chicara (*Tetracerus quadricornis*), is remarkable for having the head in the male furnished with four horns; the female is destitute of these appendages. It is a small species, about one foot eight inches in height at the shoulder, and is of a brownish tawny colour. It inhabits the woods of Bengal and several other parts of India, principally in the lower regions of the hills.

The Nyl Ghau (*Portax picta*) is an inhabitant of the northern parts of India, where it appears to be very common. It is about the size of an ordinary Stag, or four feet in height at the shoulders; the general colour of the body is ash gray, but the lower jaw and upper lip, a lunate spot on the throat, the belly, the inside of the thighs, and some spots near the hoofs are white, and the eyes are surrounded by a yellowish ring. The tail is terminated by a tuft of very long hair, and the neck furnished with a mane. The horns, which are peculiar to the male, are about seven inches in length and six in circumference at the base; they are curved upwards in a lunate form, so that their tips are nearly twice as wide apart as their bases. The Indian name of Nyl Ghau, signifies *blue ox*, and indicates that even in its native country the strong resemblance which it presents to the true Cattle has not escaped notice. The Nyl Ghau has frequently been brought to this country, and breeds pretty freely in confinement.

One or two species are common to the south western parts of Asia, and the north of Africa, and of these one is the Gazelle (*Gazella Dorcas*), so celebrated in Arab poetry. It is a most graceful little species, of a tawny colour above, and white beneath; the horns are small, black, and lyrate. In the north of Africa it appears to be the commonest species of Antelope, occurring in large troops, and furnishing a considerable portion of the nourishment of beasts of prey. The Arabs pursue them on horseback, and throw a stick at their legs, by which they are commonly broken. In the Asiatic countries they are frequently hunted with Falcons. When taken alive they are readily tamed, and their beauty then renders them great favourites with the Arab ladies. Several species nearly allied to the Gazelle are found in different parts of northern Africa, and also on the west coast of that continent, and some of the most abundant of the South African species belong to the genus *Gazella*. Of these

we may mention the Springbok (*G. Euchore*, Fig. 341), which is one of the most beautiful of quadrupeds. Its colour is a bright cinnamon brown on the back, and white beneath, and the latter colour passes up the back of the rump and continues upon the back of the loins, in the form of a broad stripe. The white of the belly is separated from the cinnamon brown of the back and sides by a stripe of dark brown, and the hair surrounding the white dorsal streak is also rather darker than the rest of the surface.



Fig. 341.—The Springbok (*Gazella Euchore*).

The head is white, with the exception of a dark brown streak on each side, which runs from the base of the horn, through the eye to the angle of the mouth, and the horns, like those of the Gazelle, are annulate and lyrate. This species occurs in immense numbers on the great plains of South Africa, and in particular seasons, when they perform migrations in search of food, their herds are so numerous as to cover the whole face of the earth over a considerable space.

Barrow frequently saw from ten to fifteen thousand of these Antelopes collected together, intent upon an incursion into the cultivated fields of the Cape colonists, when a dry season had reduced their supply of food in the open country, and Le Vaillant calculates the number of a herd seen by him at a far higher rate. The Springbok is exceedingly swift, and its activity in leaping is most extraordinary; it is from this that its colonial name is derived. Its flesh, especially that of the young animals, is very good, and a full grown individual will weigh from sixty to eighty pounds. The skins are also used by the natives of South Africa for clothing and for making bags. The Bontebok (*Gazella Pygarga*,), and the Blesbok (*G. albifrons*), are also common species in South Africa.

A fine species, inhabiting the same region, is the Water Buck, (*Kobus ellipsiprymnus*), which stands about four feet high at the shoulders, and has a pair of long curved divergent horns. It is of a yellowish gray colour, with more or less of a reddish tinge, and the buttocks are marked with a large elliptical white patch which surrounds the tail; this is referred to in the specific name of the animal. Its colonial name of the Water Buck, is derived from its constantly frequenting the neighbourhood of rivers, in which it often bathes; it also usually takes to the water in order to escape from its pursuers. It is most abundant about the rivers Limpopo and Mariqua, living in small herds of from eight to twelve in number. Its flesh is rank and disagreeable.

The Klippspringers (*Oreotraqus*), of South Africa, have a considerable resemblance to the Chamois of Europe, especially in their habits. Like the latter, they live entirely in the most inaccessible rocky parts of the mountains, in the neighbourhood of the Cape of Good Hope, upon which they climb and spring about with extraordinary agility.

The Koodoo Antelope (*Strepsiceros Koodoo*), is an exceedingly handsome species, which has apparently a very wide distribution on the continent of Africa, as it not only occurs in South Africa, but also on the west coast, and has been found in Abyssinia by

Rüppell. It is about three feet high at the shoulder, and four feet and a half in length. Its general colour is a brownish gray and on each side of the body there are from seven to nine transverse white stripes running nearly down to the belly, which, with the inside of the legs, is of a whitish colour. Above the eyes there is a V-shaped white mark, and the face has usually some white spots beneath the eyes. The horns of the male are very long and twisted into a beautiful spiral form, in the adult Koodoo they make two complete turns of the spiral, and, according to Sir W. C. Harris, the twisting of the horns is so true, that a spear might be thrust down the centre of them into the temple of the animal. The female is destitute of these organs. The Koodoo usually lives solitary or in pairs. It inhabits the woods, where it shelters itself during the day in the dense thickets, and feeds principally in the morning and evening. Its food consists partly of grass and partly of the buds and young leaves of trees and shrubs. The flesh is compared to venison.

A species supposed to be nearly allied to the Koodoo is found in Sierra Leone, which however is only known to us from mutilated skins. It is remarkable from its being of a bright reddish tawny colour, adorned with broad transverse black stripes, a coloration which is very unlike that of any other antelope. It has been described under the name of *Antelope Doria*.

The Bush Antelope (*Cephalolophus sylvicultrix*, Fig. 342) is of a more compact form than the generality of Antelopes. Its legs are shorter and thicker, and it is far less active than its fellows. It lives solitary on the bushy plateaux of the mountains of Sierra Leone, concealing itself in the thickets during the day, and feeding only in the dusk. It is about three feet high at the shoulders, and of a brown colour, with a streak of fawn colour on the hinder part of the back. Its flesh is considered good, although at certain seasons it has a musky odour. The hunters watch for it about dawn, concealing themselves in the trees. The genus *Cephalolophus* also includes one of the smallest species of Antelope (*C. pygmæus*), which has already been referred to. It is an inhabitant of South Africa, where it lives, like the Bush Antelope, solitary in the woods. A still smaller species is the *Neotragus spinigera*, a native of Guinea, which is usually about eleven inches in height at the shoulder.

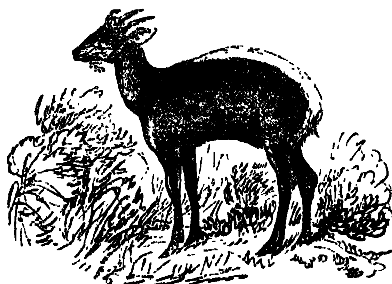


Fig. 342.—The Bush Antelope (*Cephalolophus sylvicultrix*).

The Eland, or Impophoo (*Boselaphus oreas*), is, as already stated, the largest species of the family, its size being often equal to that of a large horse, and the form of its body rather resembles that of our ordinary cattle than that of the Antelopes in general; in fact, but for its long, nearly straight, and erect horns, it might be taken at first sight for an elegant species of Ox. The breast is furnished with a dewlap, and the legs are tolerably robust, and terminated by large Ox-like hoofs. It is an inhabitant of the plains of South Africa, where it is usually seen in small herds of from ten to twenty in number. Unlike the other Antelopes, it is rather slow in its movements, and may be easily captured; and as it acquires a good deal of fat, and its flesh is well tasted, it is highly prized as food. In captivity it is very tame and gentle, and breeds

pretty freely even in England; in fact, there seems every reason to believe that this species might be completely domesticated. There are several fine specimens of it in the Garden of the Zoological Society.

The Addax (*Oryx nasomaculata*, Fig. 343) is another heavy species of Antelope, which, however, is considerably smaller in size than the Eland. It is an inhabitant of the sandy plains of North Africa, where it lives in numerous herds. The horns are long and slightly twisted in a spiral form; they were frequently used by the ancient Egyptians to indicate gods or great men; and there appears to be no doubt that the Addax was the Strepsiceros of the ancients. Several other species of *Oryx* are found in different parts of Africa.



Fig. 343.—The Addax (*Oryx nasomaculata*).

The most bovine of all the Antelopes, however, are the Gnus (*Catoblepas*), which are nearly allied to the Indian Nyl Ghau. There are two species of this genus,—the Gnu, or Wildebeest (*C. gnu*), and the Cocoon, or Bastard Wildebeest (*C. gorgon*), both natives of Southern Africa, where they live in great herds upon the plains, and migrate at particular seasons from one part of the country to another; thus they annually visit the colony of the Cape of Good Hope, from the interior of the country, in great numbers.

These animals present the most extraordinary combination of characters that can well be imagined, and at first sight it is difficult to say whether Horse, Ox, or Antelope predominates most in their general aspect. They resemble the Horse in the form of the shoulders and haunches, in the possession of a mane, and in the appearance of the tail; the large broad horns remind one of those of the Buffalo, and many of their actions are also strictly bovine; whilst the slender legs and the general characters show that they are true Antelopes.

The Gnus are about the size of a common Donkey, or three feet and a half in height at the shoulder. The horns, which are present in both sexes, have an exceedingly broad base; in old individuals, the bases of the two horns meet in the middle of the forehead, in the same manner as in the Buffaloes. For about two-thirds of their length, the horns are directed obliquely forwards and downwards, but their terminal portion turns almost perpendicularly upwards. The eyes are large and full, and surrounded by long, white, stiff hairs, which give the animals a remarkably wild aspect. The centre of the nose is covered with long, stiff, upright hairs, which add not a little to the singularity of the creature's appearance. The colour of the Gnu is dark brown, and that of the Cocoon yellowish ash colour; the latter is rathe the larger animal of the two.

They are both exceedingly swift of foot, galloping, when alarmed, in the manner of a horse; they are exceedingly wary and fierce, and when wounded will often attack the hunter with great fury. In confinement they are always wild, and usually attempt to push with their horns whenever they are approached. Their capture is attended with some difficulty in consequence of their swiftness; the Hottentots usually

kill them by lying in wait in a thicket, and shooting them as they pass. Their flesh is said to be delicate.

The only other species to which we shall refer is the Prongbuck (*Antilocapra furcifera*), an inhabitant of North America, where it and the Rocky Mountain Sheep, already alluded to, are the only representatives of this family. Both these animals are aberrant forms leading from the typical Antelopes to the Caprine, or Goat-like Bovidæ. The Prongbuck, or Cabrit, is remarkable for being the only member of this family in which the horns are furcate, and the form of these organs is indeed very singular. They are of an oval form at the base, and rise nearly straight for a considerable distance; but towards the tip they are curved strongly inwards and backwards to such an extent that they form a complete hook. A little before the commencement of the curvature they give off a short, acute prong from their anterior surface. The accessory hoofs are entirely wanting.

The Prongbuck is found in the central prairies of North America, but not further to the north than the fifty-third degree of north latitude, and is particularly abundant between the Missouri and the Saskatschewan. It also occurs between the Rocky Mountains and the Pacific. It appears probable that there may be a second species of this genus, as Dr. Gray has recently described a pair of horns from the Derby Museum, at Liverpool, in which the tips, instead of turning backwards and inwards, are directed forwards over the prongs, and bent at less than a right angle to the body of the horn. The prongs in these horns are smaller and less acute than in those of the common species.

The second group of this family includes the Sheep and Goats, in which the horns are compressed, usually angulated, rugose, and turned more or less backwards; sometimes twisted into a close spiral. Except in some of the domesticated varieties, both sexes are furnished with horns; those of the female are, however, considerably smaller than those of the male. All these animals in a wild state live in flocks in mountainous districts; the Goats generally inhabiting the rocky grounds at a considerable elevation, whilst the Sheep prefer the richer pastures towards the base of the mountains.

The Goats are distinguished by having the horns simply recurved, and by the total absence of the lachrymal sinuses and glands between the hoofs; the latter exist, without exception, in all the true Sheep. The males are also furnished with beards beneath the chin. Of the Goats (*Capra*), our common Goat (*C. hircus*) is a well-known example. Of all our domesticated animals, the Goats usually live in a condition which makes the nearest approach to a state of nature; indeed, in many mountainous parts of the country, they are positively wild. They live amongst the rocks in the higher regions of the mountains, climbing about in the most difficult parts, and leaping from one ledge or point of rock to another with the most astonishing security. The Goat is found on all the mountain ranges of Europe, and its habits are everywhere the same.

During the rutting season the males have most violent contests with each other, butting furiously with their horns. To give full effect to the stroke, the animal rises on his hind legs when close to his adversary, and then descends with his whole force and weight. The females usually produce two young at a birth; these are called kids, and their playfulness of disposition is as proverbial as that of the kitten. The Goat is easily reclaimed from its wild state, and then becomes much attached to those persons to whom it is accustomed; it has, however, a disagreeable smell. Many people keep Goats in their stables, from a belief that the smell of these animals is beneficial to the Horses; it seems more probable, however, that it is to

the companionship of the Goat that any good effect its presence may have is to be attributed.

The Goat is an exceedingly useful animal; and as it may be kept in places where neither Cattle nor Sheep would thrive, it is often of great importance to the inhabitants of mountainous regions. Its flesh, especially when young, affords an excellent article of food, and the milk furnished by the female is very good; and although it gives but little cream, and cannot therefore be applied to the manufacture of butter, it may be made into a tolerably good cheese. The body is covered with long hair, which in some varieties, such as the Angora and Cashmir Goats, attains a great length and a silky texture; the hair covers an undercoat of fine soft woolly down, and this is the material of the celebrated Cashmir shawls. The hair of inferior varieties is also woven into a variety of fabrics, which usually have the property of resisting water in a high degree. The skin, when tanned, furnishes some of the most admired kinds of leather, of which the well-known and expensive morocco leather is an example; the skin of the kid also gives a most delicate leather, which is constantly used for gloves and similar purposes. Besides the varieties above referred to, the Goat undergoes many changes in different climates, but to these we need not allude.



Fig. 344.—The Jemlah Goat (*Capra Jemlahica*).

The original wild stock of the Goat is not known with any certainty; but most modern zoologists derive it from the Wild Goat of the Caucasus and Persia (*Capra Aegagrus*), which is also called the Bezoar Goat, from the peculiar concretion called *bezoar* which is found in its intestines. A fine Wild Goat from the mountains of Central Asia is the Jemlah Goat (*Capra Jemlahica*, Fig. 344), which is destitute of a beard, and has large compressed horns, with anterior keel strongly nobbed. It is considered by modern zoologists to be a variety of a short-horned species inhabiting the mountains of Nepal, the Jharal (*C. Jharal*). The latter species is frequently tamed, and, although, in a wild state it dwells in the highest parts of the mountains, it bears the climate of the Nepalese valleys very well.

The remainder of the genus *Capra* consists of the several species of Ibex, distinguished by their large recurved horns, flattened and nodose in front, which, however are sometimes wanting in the females. These animals are inhabitants of the highest mountains; amongst the rocks of which they climb about with the most wonderful agility. Two species occur in Europe—one the Common Ibex (*C. Ibex*), on the Alps; the other the Pyrenean Ibex (*C. Pyrenaicus*), on the Spanish side of the Pyrenees. They are both rapidly declining in number, and will probably soon be extinct. Three species are found upon the mountains of Asia, and two upon those of Abyssinia and Nubia.

Intermediate between the Sheep and the Goats is the *Ammotragus Tragelaphus*, or

Aoudad, a remarkable species of Sheep which inhabits the mountains of the north of Africa, from Abyssinia to Barbary. Like the Goats, it wants the lachrymal sinuses; but it agrees with the Sheep in the possession of a gland between the hoofs. It is of a reddish-brown colour, and on the front of the neck and the base of the fore legs it has a large quantity of long hair hanging down, which gives it a singular appearance. It is exceedingly fierce, butting violently at its assailants with its long powerful horns. It lives in small flocks in the mountains, and does not appear to be particularly abundant.

The True Sheep (*Ovis*) are distinguished from the Goats by the possession of lachrymal sinuses, and of glands between the hoofs; their horns are also frequently twisted into a spiral. The Common Sheep (*Ovis Aries*) is an example of this genus; but it has undergone so many changes in consequence of its domestication, that it is difficult to say what were the original characters of the species. It is generally supposed, however, that the wild stock of all our domesticated varieties is to be found in the Moufflon (*Ovis Musimon*), a wild Sheep which inhabits the islands of Sardinia and Corsica. The coat of this animal is very different in its appearance from the well-known woolly covering of our Common Sheep, consisting apparently of hair; but Professor Bell states that this hair is identical in structure with true wool, so that cultivation has only increased its length and modified its appearance. It must be confessed, however, that there is still something unsatisfactory about this theory of the origin of the Sheep; and it is quite possible that our domesticated species, like the Camel, and some others, may have been completely subjugated at an early period, so that we may seek in vain for its wild representatives.

The Sheep appears to have been one of the earliest animals to come under the dominion of man, and in all parts of the Old World some breed of this valuable animal constitutes a part of the property of the inhabitants. It is adapted to all climates, but appears to thrive best in temperate regions,—at least it is here that its wool and flesh, its two most important products, attain their greatest perfection. Some breeds, such as the Merino Sheep, are kept almost exclusively for the sake of their wool, which is of very superior quality; but by the judicious management to which our English Sheep have been subjected for many years, some of our breeds have been brought to such a state of perfection, that they not only rival the best Merinoes in the fineness of their fleece, but also furnish meat of the best quality. In Australia, also, where the climate is temperate, Sheep thrive wonderfully, and produce fleeces of the finest description. In tropical climates the wool of the Sheep degenerates into hair, and the animal would scarcely be recognized as belonging to the same species.

Amongst the more remarkable varieties, we may notice the large-tailed sheep of Western Asia, in which the tail is enormously increased by an accumulation of fatty matter, so that it sometimes weighs as much as seventy or eighty pounds.

In rocky mountainous districts the Sheep exhibits almost as much agility as the Goat, and springs from one small ledge of rock to another with a certainty which is truly astonishing, especially when we contrast it with the apparent dullness and stupidity of the ordinary denizens of our meadows. Even on the cliffs of our southern coast, according to Mr. Bell, frequent instances of the climbing powers of the Sheep may be observed; and he mentions that, on the southern coast of the Isle of Wight, the Sheep frequently descend from the downs on the summit of the cliffs nearly to the bottom, although the cliffs are several hundred feet in height, and the ledges by which they descend are scarcely perceptible from the sea.

The other species of Sheep are all, with one exception, inhabitants of the mountains of Asia. The exception is the Bighorn (*Ovis montana*) of the Rocky Mountains of America,—a large species, the male of which is furnished with an enormous pair of horns. In this respect, and indeed in its general characters, the Bighorn agrees so closely with the Argali (*O. argali*) of Central Asia, that the two species were formerly regarded as identical.

The last section of this family includes the true Bovine quadrupeds, of which our domestic cattle may be taken as the types. In these animals the horns are round, tapering, and usually curved outwards and upwards in a lunate form, and the bony core is cellular.

Amongst our domestic animals the Ox must certainly take one of the highest places. Unlike the Sheep and the Pig which are bred only for the sake of the products to be immediately obtained from them, the Ox not only benefits us after his death, but is an invaluable agent in performing all sorts of heavy draught work, and it is not until he has fully done his duty in this way that he is usually fattened up for the butcher. When he is killed, however, there is not a part of him but is put to some use; his flesh, his fat, his blood, his skin, hair, horns, bones, and intestines, all bear a certain value and serve particular purposes. The female furnishes us with the best milk we can procure, as it is equally adapted for the production of both butter and cheese, a property which seems to be possessed by no other kind of milk. It is also in very large quantity.

With these advantages, it is no great wonder that the Ox should have been one of the first animals to fall under the dominion of man, as every testimony concurs in proving that it must have been. Like most of our domestic animals, in fact, the original stock of the Ox is entirely unknown; but fossil bones have been found in different parts of this country which agree so closely with those of some of our domestic breeds as to leave little or no doubt of their identity, whilst in some few parks in this island a few individuals of a wild breed of cattle are still preserved; and these are said to be representatives of the pure wild species. These are commonly known as the Chillingham Cattle (Fig. 345); but many zoologists doubt their being the residue of the original wild stock of our domestic breeds (*Bos Taurus*), rather regarding them as the descendants of individuals which had escaped from captivity, whilst others maintain that they are the representatives of a distinct species, to which they give the name of *Bos Scoticus*.

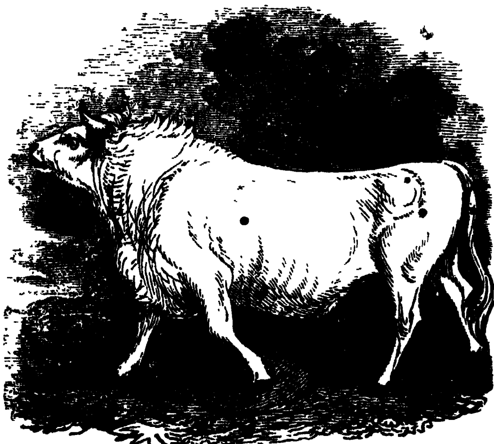


Fig. 345.—Chillingham Bull (*Bos Scoticus ?*).

The diversity between the different breeds of Oxen in the general form and colour, and especially in the size of the horns, is most remarkable; but we cannot enter upon this branch of the subject, except to notice the singular Indian variety, called the Zebu, or Brahmin Bull, which has a large fatty hump on the shoulders. This animal is found in India, China, and the Indian islands, and also on the east coast of Africa.

The Buffaloes (*Bubalus*), which are also to a certain extent domesticated animals, are awkward-looking and ungainly creatures, with the horns usually very large, and meeting with their bases in the centre of the forehead. The skin is almost naked, being only furnished with scattered bristle-like hairs; and the aspect of the animals is usually ferocious and disagreeable. The best known species is the Common Buffalo (*Bubalus Bubalis*, Fig. 346), which is domesticated in India and all parts of the south of Asia, and has also been introduced into Egypt and the southern countries of Europe. A variety of this species called the *Arnee* has the horns of immense size, each horn measuring sometimes five or six feet in length.



Fig. 346.—The Common Buffalo (*Bubalus Bubalis*).

Of the Bisons (*Bonasus*) there are two species—one a native of Europe, the Aurochs (*Bonasus Bison*, Fig. 347); the other an inhabitant of North America, the American Bison (*B. Americanus*). Anciently the Aurochs, also called the Urus and European Bison, abounded in all those parts of Europe which were covered with forests; but it is now almost extinct, being only preserved in one locality in Europe, where it is protected by command of the Emperor of Russia. When full-grown it is a gigantic animal, larger than any of our native cattle, of which, however, it has been supposed by some naturalists to be the original stock. The American Bison is found in countless herds upon the vast prairies of North America, and was formerly distributed over a



Fig. 347.—The Aurochs (*Bonasus Bison*).

great part of that continent; but, like the Indians whose principal support it is, it has gradually retired before the Europeans, and will probably, before many years have passed, be also an extinct species. Both the species of Bisons are very large and powerful animals, and their ferocity is very great. Their horns are short, their shoulders are very high, and the fore part of their bodies is covered with a sort of mane.

A remarkable species of this group is the Yak (*Poëphagus grunniens*), a native of Thibet, which is furnished with a curious thick fringe of long hair falling down from the lower part of the body, so as nearly to touch the ground. The Wild Yak is a large animal, of a black colour; it lives upon the mountains of Thibet and other parts of Central Asia, at an elevation close to the line of perpetual snow. The tame individuals vary in colour and size, probably from an intermixture of common Cattle; but they still retain the extraordinary fringe of hair round the lower parts.

But, perhaps, the most singular species is the Musk Ox (*Ovibos moschatus*), a native of the Arctic regions of America, in which the whole of the hair is of such a length as almost to reach the ground, so that the animal, which is not very large, has rather the appearance of a very long-haired Goat than of a true Ox. From this character its generic name *Ovibos* is derived, and it is called the Musk Ox from a strong odour of musk which it evolves.

### Order VII.—Edentata.

**General Characters.**—The distinguishing characteristic of this remarkable order of Mammalia, is to be found in the total absence of the incisor teeth in all the species with the exception of one Armadillo (*Dasypus setosus*), in which a single tooth is found in each intermaxillary bone, but placed so completely at the sides of these bones, that the front of the mouth is quite destitute of teeth. The canine teeth are also deficient in most of the species, and some are even destitute of molars, so that the jaws exhibit no trace of teeth. The teeth are exceedingly simple in their construction and quite destitute of roots, and the structure of all the teeth is very similar.

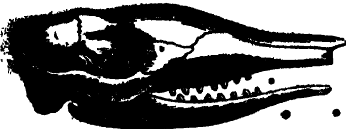


Fig. 348.—Skull of the Armadillo.

The structure of the skeleton varies considerably according to the particular habits of the animals; in some it is adapted for terrestrial progression, whilst in others it is remarkably fitted for climbing up trees. The toes are furnished with very long and powerful curved claws.

The skin is sometimes covered with hair, sometimes with horny or even bony scales or plates; the external ear is frequently wanting, and the tail varies greatly in its development, being sometimes of great length, sometimes rudimentary. The mammæ are two in number and placed on, or near the breast; and with the exception of the Armadillos, they always produce a single young one at a birth.

The Edentata are all confined to the tropical parts of the world and principally to the southern Hemisphere. They are sluggish animals, for the most part nocturnal in their habits; some of them live upon vegetable and some upon animal food; the former are arboreal in their habits, whilst the latter are terrestrial, and generally burrow in the earth. They are generally of small or moderate size; but the remains of some gigantic extinct species have been found in South America, which is still the country in which the Edentata most abound.

**Divisions.**—The recent Edentata form three families.—The first of these, that of the *Myrmecophagidæ*, or Ant-eaters, is distinguished by the remarkable structure of the tongue, which by a peculiar arrangement of the muscles of which it is composed, is capable of being protruded from the mouth to a great length, and again retracted at the pleasure of the animal. The tongue is almost entirely composed of annular or ring-like muscles, and it is by the contraction of these that its extraordinary extensibility is produced. It is usually of cylindrical or worm-like form, but in the genus *Orycteropus*, it is flattened and strap-shaped. Its surface is smooth, and indued with a viscous matter, and it thus becomes instrumental in enabling these creatures to procure their food, which consists entirely of insects, and principally of Ants and Termites; the



Fig. 349.—The Great Ant-eater. (*Myrmecophaga jubata*).

tongue is exserted amongst the crowds of these insects, which then adhere to its surface, and are drawn back into the mouth by its contraction. The jaws are elongated, but the external opening of the mouth is of very small size, so that without this extensible

tongue, the animals of this family would be unable to procure their nourishment. In the majority, the jaws are quite destitute of teeth; these organs occur only in one genus, (*Orycteropus*) including two species, both natives of Africa. The *Orycteropoda* are also the only species of this family in which the ears attain any considerable size.

The legs are rather short, but very powerful, adapted for terrestrial motion, and armed with very strong claws, which are employed by the animals in digging into the Ant-hills in search of their favourite food, the Ants and White Ants crowding into the breach, as soon as they find their dwelling is invaded, and thus giving their enemy an excellent opportunity of inserting his long tongue amongst their ranks.

One of the most remarkable species of this family is the Great Ant-eater, (*Myrmecophaga jubata*, Fig. 349), sometimes called the Ant-Bear, an inhabitant of most of the tropical parts of South America, eastward of the Andes, although apparently rather scarce everywhere. It is the largest species; a full grown specimen measuring four feet and a half in length from the snout to the root of the tail, which in its turn measures nearly three feet in length; these at least were the dimensions of the large female which was living in the Zoological Gardens in 1854. The average size is said to be between six and seven feet in total length.

The Great Ant-eater is a most singular creature in its appearance. Its head is produced into a long snout covered with skin, which only leaves a very small opening at the tip for the protrusion of the tongue; its ears are very small; its legs are rather long and excessively stout, especially the anterior pair, the long powerful claws of which, four in number, are turned inwards against the naked soles, so that the creature walks upon its knuckles. The hind feet are furnished with a broad sole, and it is probably from this circumstance that it has been compared to a Bear. The body is covered with harsh, bristly hairs, which attain an immense length on the tail, from which they hang down perpendicularly so as to touch the ground. When reposing, the Ant-eater covers himself completely with this bushy tail, which gives the sleeping animal very much the appearance of a heap of dried grass, and he is said to resort to the same natural umbrella in case of a shower of rain; according to Mr. Wallace the Indians are so well aware of this that when they meet with an Ant-eater, they shake the leaves to produce a sound like that of rain, and then knock him on the head whilst he is taken up with sheltering himself from the expected shower.*

The Ant-eater lives both in the forests and in open places, but principally on the borders of rivers and lakes, where the White Ants abound. He breaks into their dwellings with his powerful anterior claws, and takes them up in great numbers by means of his tongue, which can be protruded to a distance of a foot and a half. He is a slow moving animal and is easily killed with a stick; when attacked he will sometimes rise upon his hind legs, and clasp his enemy round the waist with his powerful arms; the Indians even report that the formidable claws with which these are armed, render him more than a match for the Jaguar; but this is evidently absurd. In confinement the Great Ant-eater is a gentle creature; those lately in the Zoological Society's Menagerie, were fed with a mixture of egg and finely chopped meat.

The smaller species of the genus *Myrmecophaga*, are found in different parts of South America; they are remarkable for having the lower part of the extremity of the tail naked, forming a prehensile organ, by the assistance of which, these animals are enabled to climb trees.

The remaining species of this family are inhabitants of the tropical parts of the Eastern Hemisphere. Of these the most remarkable are the Pangolins (*Manis*, Fig. 350)

of which some species are found in Africa, and others in the Southern parts of Asia and the Asiatic Islands. The body in these creatures is entirely covered with overlapping horny scales of great strength, which constitute a formidable armour when the animals roll themselves up into a ball, as their habit is when alarmed. They are rather small animals, the largest being not more than between three and four feet in length, including the tail, but their strength is very great, and the power of their claws in digging is most astonishing.



Fig. 350.—The Pangolin. (*Manis*).

The genus *Orycteropus*, includes only a single well known species, the *Aardvark*, or Ground Pig of the Cape (*O. capensis*). It occurs in all parts of South Africa from the Senegal to the Cape of Good Hope, and burrows with great rapidity in the ground. In its food and its manner of procuring it, it resembles the true Ant-eaters, as it does also in its general structure, but its burrowing habits and the possession of molar teeth indicate an approach to the next family.

This is the family of the *Dasypodidæ*, or Armadillos, in which the jaws are always furnished with numerous simple molar teeth, and the mouth is capable of opening to a much greater extent than in the Ant-eaters; the form of the head and jaws (Fig. 348), is however very similar to that which prevails in the preceding family, especially in the genus *Orycteropus* The teeth are exceedingly numerous in some species, the *Dasypus gigas* having in all upwards of ninety molars. The tongue is comparatively short and fleshy. The whole upper part of the body is covered with a number of bony plates, of which those on the middle of the body are quadrangular, and arranged in transverse bands, the number of which varies according to the species. The legs are very short and strong; the feet are armed with long and powerful claws, by the assistance of which the Armadillos burrow with such expedition, that a traveller has scarcely time to dismount from his horse to capture one before his intended booty is beyond his reach. Even the Great Armadillo or Tatu (*D. gigas*), although upwards of three feet long in the body has been known to form a burrow considerably longer than himself within three minutes from the time of his perceiving the vicinity of an enemy, and when these animals have once got beneath surface, they fix themselves so firmly with their feet that it is impossible to drag them up again.

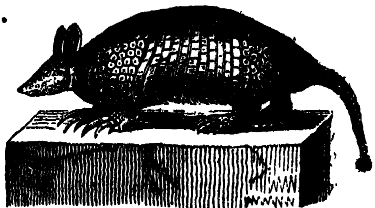


Fig. 351.—The Cabassou (*Dasypus 12-cinctus*).

These animals are found in South America, where they are distributed everywhere, from Mexico to the Straits of Magellan. They live on the borders of woods, where they dig themselves burrows in which they usually pass the day, wandering about at night in search of their food, which consists almost exclusively of insects and worms: in pursuit of Ants and White Ants they are said to dig under the dwellings of those

insects, so as to feast upon them at their leisure. They are also said to visit carrion, and occasionally to feed on soft vegetable matter. The smallest species, *Dasypus minutus*, is only about ten inches long in the body; the largest is the *D. gigas*, already referred to. The flesh of all the Armadillos is eaten by the Indians; but the Europeans are more dainty, and eat only particular species. In the tertiary strata of South America, the remains of some gigantic species of this family have been discovered (*Glyptodon* &c.).

The third and last family of the recent Edentata is composed of the Sloths or *Bradypodidæ*. In these animals the head is small and rounded, and the jaws instead of being produced into a pointed cone as in the preceding families, are very short, so that the face projects very little in front of the cranium. The malar bone is remarkable in its form, from its giving off two free processes; the zygomatic process runs backwards, but passes above the corresponding process of the temporal bone without touching it, whilst a second process descends outside the lower jaw. The latter is very strong, and both jaws are armed with molar and canine teeth. The molars are four in the upper and three in the lower jaw, and of a nearly cylindrical form, and the canines are very small. The tail is excessively short or entirely wanting.

There are few animals which exhibit in a greater degree what appears to the careless observer to be *deformity*, than the Sloth, and none that have on this account been more maligned by naturalists even of high standing. Buffon, and many of the older zoologists, were eloquent upon the supposed defects of the unfortunate Sloth.—We are gravely told by these writers, that when the Sloth ascends a tree for the purpose of feeding on its leaves, it is so lazy that it will not quit its station until every trace of verdure is devoured, nay some of them went so far as to assert that when this was the case, and the Sloth was compelled to look out for a fresh supply of sustenance, it would not take the trouble to descend the tree, but just allow itself to drop from a branch to the ground. Even Cuvier, who ought to have known better, echoes this tale, and insinuates that Nature, probably becoming weary of perfection, "wished to amuse herself by producing something imperfect and grotesque" when the Sloths were formed; and he proceeds with great gravity to show the great "inconvenience of organization" which in his opinion rendered the Sloths unfit for the enjoyment of life.

It is perfectly true that on the ground, these animals are about the most awkward creatures that can well be imagined, for their fore legs are much longer than the hind ones; all the toes are terminated by very long curved claws, and the general structure of the animals is such as entirely to preclude the possibility of their walking on all fours in the manner of an ordinary quadruped. In this, which is an unnatural situation, they certainly appear the most helpless of animals, and their only means of progression consists in hooking their claws to some inequality in the ground, and thus dragging their bodies painfully along. But in their natural home, amongst the branches of trees, all these seeming disadvantages vanish, nay, the very peculiarities of structure which render the Sloths objects of pity on the ground, are found to adapt them the better for their true mode of existence.

The structure of the anterior extremities agrees very closely with that of the same parts in man, and these members possess great freedom of motion. The feet are however very different in their construction from the human hand; the bones are firmly united together, and give support to enormous claws which are turned inwards in repose, and rest against the palm. With these the Sloths cling firmly to the branches of the trees, from which they hang with their backs downwards, and as it is in this

position that their whole existence is passed, we can easily see that the mobility of the bones of the arms, coupled with grasping arrangement is peculiarly adapted to give them security and freedom of motion in their arboreal residence. Thus we see that so far from being a mere freak of nature, the Sloth is specially fitted for enjoying a particular mode of existence, and that it is most absurd to come to any conclusion with regard to the powers of any creature from seeing it in an unnatural position. The Sloths seldom, if ever, visit the ground in a state of nature, and indeed have no reason for doing so, for in the great forests of South America, which they exclusively inhabit, the trees grow so close together, that these animals can pass with facility from one to another, especially when strong winds wave the branches of the trees and thus bring them into closer juxtaposition.



Fig. 352.—The Ai, or Common Sloth. (*Bradypus tridactylus*).

The Sloths are found in the eastern parts of South America, from the neighbourhood of Honduras, as far south as Paraguay. They are rather small animals, the body rarely exceeding two feet in length, and are covered with a woolly hair. Their food consists entirely of the leaves of trees. They produce one young one at a time, and the little animal for some time after its birth clings to the back of its mother, where it is concealed amongst the long hairs.

Allied to the Sloths and apparently uniting the Edentata with the Pachydermata, is a remarkable family of extinct Mammalia of colossal proportions, the remains of which have been found in the tertiary strata of some parts of South America. In the structure of the head and jaws, these animals agreed closely with the Sloths, but as from their great size they were of course incapacitated for ascending trees, the conformation of their limbs has been modified to enable them to walk upon the ground. In this respect, therefore, these gigantic extinct creatures may be considered as intermediate between the Sloths and the Armadillos, and indeed they were at one time considered to be most nearly allied to the latter, and it was supposed that they were furnished with a covering of bony plates; this, however, is now found to be incorrect. The humerus and femur in these animals were very short; the radius, as in the Sloths, possessed a rotatory motion, and the feet, which were of enormous size, were furnished with hoof-like nails on the outer, and long claws on the inner toes. The principal genera of this group are *Megatherium*, *Mylodon* and *Megalonyx*. From the structure of their teeth it is evident that their food must have been of the same nature as that of the diminutive Sloths of the present day; but as they could not ascend the trees, and their feet are evidently formed for digging, it is supposed that they must have uprooted the trees in order to get at their foliage. The largest species were of the size of a Rhinoceros or Hippopotamus.

## ORDER VIII.—RODENTIA.

**General Characters.**—The Rodentia, or gnawing Mammalia, form the first of the truly unguiculate orders. They are all of small size, many of them the most diminutive of their class; but the species are exceedingly numerous and usually very prolific, so that no Mammalia are more generally or abundantly distributed.

Their most conspicuous character is to be found in their dentition, which is very peculiar, and only occurs elsewhere in a remarkably aberrant form of the Quadrumana. The teeth are of two sorts, incisors and molars, the canine teeth being entirely deficient. The incisors are two in number in each jaw; their bases pass far into the jaw, where usually, beneath the molar teeth, there is a permanent pulp, by the action of which the incisors are kept constantly growing during the life of the animal, so as to supply the continual wear going on at the extremities where the upper and lower teeth come in contact. The substance of the body of these teeth is moderately soft, but their anterior surface is covered with a layer of very hard enamel, secreted by a membrane coating the anterior wall of the socket. The thin layer of hard enamel which coats the front of the tooth resists abrasion much better than the dentine of which the body of the tooth is composed; the latter consequently wears away most rapidly, and thus the enamel always constitutes a sharp projecting edge like that of a chisel, of which the dentine forms the bevelled portion. The object of this arrangement is very apparent. These animals feed to a great extent upon hard substances, or substances enclosed in hard coverings, such as nuts, &c.; and in order to get at their food they require both sharp and strong teeth; the requisite sharpness is furnished by the thin plate of enamel; but as this by itself would break away directly when applied to its ordinary purposes, it is strengthened by a thick layer of dentine, which, although it furnishes the necessary support, wears away so readily as never to interfere with the efficiency of the cutting edge. This efficiency is, in fact, only preserved by constant use; and when one of the incisor teeth is broken away, the one opposite to it, being deprived of all check upon its growth, continues to increase in length like the tusk of the Elephant; but as the form of the socket is a segment of a circle, the tooth is developed in a circular form, and may thus in time prevent the animal from taking any nourishment. A remarkable instance of the abnormal growth of one of the incisor teeth of a Beaver is noticed by Professor Owen, in his Treatise on the Forms of the Skeleton. (*Organic Nature*, vol. i. p. 283).



Fig. 353.—Skull of a Rodent Mammal.

Behind the incisors there is a large gap, beyond which the molars are situated. These vary in number from two to six, and are usually destitute of true roots; in fact, like the incisors, they generally continue growing throughout the animal's existence. They are sometimes composed of a simple prism of dentine coated with enamel; the latter is sometimes folded so as to produce transverse ridges at the surface of the tooth, which is usually worn flat, and in some cases exhibits small isolated spots of enamel in the body of the dentine. These teeth are evidently adapted for the comminution of vegetable substances; and although many of these animals are omnivorous, there is no doubt that vegetable matters constitute the principal part of their nourishment.

The skull is small, and the jaws, especially the lower one, large and strong. To give full action to the gnawing incisors, the lower jaw is articulated to the skull by an elongated condyle, which allows it to move freely backwards and forwards. The head is more or less rounded, with the snout pointed, and usually furnished with long moustaches. The opening of the mouth is small, but the cheeks often form large pouches, in which the animals can convey food to the hoards which they lay up in their dwelling-places. The brain is small, and exhibits scarcely any convolutions;

and the cerebellum is almost entirely exposed. In these characters the Rodentia approach the Marsupial animals, close to which they are indeed placed by many zoologists. The legs are generally short, and adapted either for walking or climbing; the feet are furnished with four or five free toes, armed with nail-like claws; but the thumb is never opposable. The eyes and external ears are usually of moderate size, but the latter sometimes attain a great length. The skin is generally covered with soft hair, but in some cases with bristles and spines. The tail varies greatly in its development, and is sometimes naked or scaly, and sometimes covered with hair.

The Rodents are distributed in all parts of the world, even New Holland possessing apparently indigenous species. Very few are domesticated; but the flesh of some species is eaten, whilst the skins of others are sought after as furs. Notwithstanding their small size, their great numbers, their habit of storing up large quantities of provisions, and their extraordinary propensity for gnawing, cause them to commit great devastations in many places.

**Divisions.**—The immense number of species included in this order has necessitated the formation of numerous families. In the following sketch we have followed Professor Wagner's arrangement, with scarcely any deviation.

The first family is that of the *Leporidæ*, or Hares, which are at once distinguished from all the other Rodents by the possession of a small additional incisor behind each of the two large chisel-like incisor teeth in the upper jaw. They also present several other remarkable characters, amongst which we may notice that the orbits communicate with each other through an aperture in the septum, a structure which is characteristic of the class of birds The maxillary bones are pierced with numerous sieve-like holes, a character which is otherwise peculiar to the Ruminants. The molar teeth have a transverse ridge of enamel, so that they appear to be composed of two halves; they are usually six in the upper and five in the lower jaw, but in some species the upper jaw has only five molar teeth. The Leporidæ are all strictly herbivorous animals.

The Common Hare (*Lepus timidus*) and the Rabbit (*L. cuniculus*) are such familiar examples of this family, that any detailed description of their form will be unnecessary. We need only notice that in all these animals the hind legs are considerably longer and stronger than the anterior limbs, and from this cause their motions consist essentially of a succession of leaps. The clavicles are usually imperfect. They are generally very prolific animals, and both the Hare and the Rabbit possess five pairs of mammæ—two on the breast and three on the belly. The species are distributed over the whole earth, with the exception of Australia; but they are most plentiful in the temperate parts of the Northern Hemisphere. In tropical countries they are comparatively rare.

The common Hare of this country is distributed in most parts of Europe. It may be taken as the type of the true Hares, in which the disproportion between the fore and hind legs attains its highest degree, and its habits may therefore serve to exemplify those of that group of the family. The Hare frequents thickets, where it rests during the day in a shallow depression, which it makes on the surface of the ground, and comes abroad at night to feed on the tender herbage. This resting place is called the *form*, and the Hare's attachment to it is proverbial; it shifts its residence, however, with the season, so as to get a warm place in the winter. Its senses are exceedingly acute, and give it timely notice of the approach of danger; when pursued it runs with the greatest swiftness, and adopts a great variety of expedients to escape from its enemies. It takes the water freely, not only when pursued, but in

passing from one place to another, and the "Magazine of Natural History" contains an account of a Hare being seen to swim across an arm of the sea a mile in breadth, apparently on his return, like another Leander, from his beloved, who came down to the shore to see him off. The chase of the Hare is a favourite sport in most countries, and its flesh is very highly esteemed; the ancients even attributed medicinal properties to it. It has frequently been tamed, and appears then to be an amusing pet. In cold climates it is said to become white in the winter, but this phenomenon is presented in a more striking manner by some of the northern species, of which the Alpine Hare (*L. variabilis*), which is also an inhabitant of this country, is an example. North America possesses numerous species of Hares; in some of these the tail is upwards of five inches long. In the Rabbit (*L. cuniculus*), the hind legs are much shorter than in the Hare, and as the animal is in consequence far less swift of foot, it resorts to a different mode of escaping from its enemies. Instead of a slight cavity in the surface of the earth, the dwelling of the Rabbit consists of a deep burrow, into which it vanishes with the quickness of thought the moment any danger approaches it. Rabbits live together in large communities, and the places in which they form their burrows are called *warrens*. They prefer a sandy soil overgrown with furze, the prickly branches of which not only serve to protect the entrances of their burrows, but also furnish them with an abundance of food. They nevertheless make frequent incursions into the cultivated fields in their vicinity, where they often do considerable damage to tender herbage. A rabbit warren is a profitable concern, as the flesh is highly esteemed, and the skins, especially when they are of a particular shade of colour, are of some value. The Rabbit is one of the two species of Rodents which have been domesticated; the tame varieties, both as to form and colour are very numerous.

The Calling Hares (*Lagomys*), in which there is but little difference between the length of the fore and hind legs, are found only in the colder regions of the north, or at a considerable altitude on the mountains of the warmer or temperate climates. They have a curious piping note or call, and form large stacks of fodder for their winter supply. They burrow in the ground, and are said to form a gallery leading from their ordinary dwelling to their supply of food, so that they may have access to it at any time.

The second family is that of the *Cavidæ* or Cavies, the general form of the animals composing which has a good deal of resemblance with that of the Hares, although the body is stouter and the inequality of the limbs is much less. In the Cavies the tail is either rudimentary or entirely wanting; the toes are furnished with hoof-like nails, and the ears are short. The clavicles are imperfectly developed. The molar teeth are four in number on each side in each jaw; they usually exhibit more or less complicated folds of enamel, but in some



Fig. 354.—The Capybara (*Hydrochærus capybara*).

cases are composed of separate columns of that substance and dentine, united by cement. The mammæ are variable in number, sometimes numerous, but the females appear only to produce from two to four young at a birth.

These animals are all strictly terrestrial and herbivorous in their habits; they generally live in holes, which they dig for themselves. They are entirely confined to South America, where they occur principally in the warm regions.

This family includes some of the largest species in the order; the Capybara (*Hydrochærus capybara*, Fig. 354) measuring about three feet in length. This animal has much the appearance of a small pig, and its body is covered with bristles; it is an inhabitant of watery places in the warmer parts of South America, where it is generally seen in small flocks, and takes to the water when alarmed. It swims well, and the three toes of the hind feet are united by a short swimming membrane. The flesh of this animal is very good, and it is said to be a favourite prey with the Jaguar.

The Agoutis (*Dasyprosta*) present a considerable resemblance to the Capybara in their general form, but are lighter in appearance, and supported upon more slender legs. They inhabit the forests of South America, eastward of the Andes, where they lie concealed during the day. The common Guinea Pig (*Cavia aperæa*) is a well known domesticated species of this family. In its wild state, the fur of the Guinea Pig is a mixture of orange and black, with the under surface dull yellow, the domesticated specimens, as is well known, are usually patched with white, black, and orange. It inhabits dry bushy places, and its flesh is said to be good.

The *Hystricidæ*, or Porcupines, are at once distinguished from the other Rodentia by the spiny covering of their bodies, which, however, in some of the American species is almost concealed by the fur. The skull is remarkable for the great size of the infra-orbital foramen, and the molars, of which there are four on each side of each jaw, are furnished with distinct roots, and with complicated folds of enamel. The clavicles are incomplete.

The name of Porcupine given to these animals is derived from the French name, and signifies "Spiny Pig," a denomination which is justified not only by the heavy pig-like appearance of the animals, but also by their peculiar grunting voice. They are found in both hemispheres, but those of the Old World differ greatly in their habits from those of the American Continent.

The species of the Eastern Hemisphere are confined to the warmer temperate and tropical regions. They are strictly terrestrial animals, living in burrows, where they pass the day, their period of activity being nocturnal. The majority are furnished with a short spiny tail, the apex of which bears a tuft of small open horny tubes; but in two species, forming the genus *Atherura*, the tail is long and scaly and terminated by a tuft of long bristles. The best known species is the common Porcupine (*Hystrix cristata*) one of the largest of the Rodentia, which inhabits the south of Europe and the north of Africa. The head and neck are covered with a crest of long stiff bristles, and the body with long spines, sometimes upwards of a foot in length, and marked with alternate rings of black and white. These spines are erected when the Porcupine is irritated or alarmed, and thus form a most efficient protection, but the old notion that he could project them like darts, at his enemies, is totally destitute of foundation.

The American species, of which there are at least seven, differ from the Eastern Porcupines in their habit of ascending trees, and with the exception of one species, the

*Erethizon dorsata*, or North American Porcupine, they are all furnished with long prehensile tails. The species thus provided form the genus *Cercolabes*, and they are peculiar to South America. The northern species occurs as far north as latitude 67° N., on the shores of the Mackenzie River. The spines in all the American species are much smaller than those of the Old World Porcupines.

The *Castoridæ*, or Beavers, are large, stout-built Rodents, with five toes on all the feet, and those of the hinder pair united by a swimming membrane. The incisor teeth are of great size and strength, and the molars, of which there are four on each side in each jaw, exhibit a most complicated arrangement of the enamel (Fig. 355), which forms three folds on one side of the tooth, and a single fold on the other. The tail in one of the genera included in the family, is broadly depressed, ovate, and scaly; in the other it is rounded and clothed with hair.


Fig. 355.—Molar Teeth of the Beaver.

The most celebrated species of this family is the Beaver (*Castor fiber*), a large Rodent which is found in the northern parts of both hemispheres. By some zoologists, indeed, the American Beaver is considered to be distinct from that inhabiting Europe and Asia; but no one has yet succeeded in finding characters of sufficient importance to justify their separation. In Europe the Beaver is now scarce, but it still occurs in some places; it has, however, been long since extirpated in Britain, although there is good evidence of its having once been an inhabitant of our island. Even in Canada the Beaver is growing rare, its disappearance being principally owing to the great numbers destroyed for the sake of their skins, which are employed in the manufacture of hats.

The Beavers are aquatic animals, and are always met with on the banks of rivers. Here they make large dams with the stems of trees, plastered with mud to keep out the water, and, with the same materials, build themselves rude dwellings in the water. The stories of their wonderful ingenuity in building, which would almost lead one to suppose that they dwelt in palaces, all owe their existence to the fertile imaginations of the Canadian hunters. It appears that, when molested by man, the Beavers quit their ordinary habitation, and burrow in the banks of the stream.

The fur consists of two kinds of hair—one long and rigid, forming the outer coat, the other soft and downy; it is the latter that is employed in manufactures. Besides the fur, however, the Beaver furnishes a substance well known in medicine under the name of *castoreum*, which is secreted in a pair of sacs situated in the neighbourhood of the generative organs. The American castoreum is said to be inferior to that produced by the Beavers of the eastern hemisphere.

This family only includes another animal, the Coypu (*Myopotamus coypu*), which differs from the Beaver in its round hairy tail. It is a native of South America, where it lives, like the Beaver, in the vicinity of water, and burrows in the banks of streams. It is a much smaller animal than the true Beaver, but its skin has been substituted for that of that animal, and as many as 800,000 of these skins have been imported in one year from South America.

The next family is that of the *Muridæ*, or Rats, of which our common Rats and Mice may be taken as typical examples. The general form of these animals is too well known to need description, and we shall, therefore, confine ourselves to the characters by which the family is distinguished from its neighbours. In the Muridæ the tail is more or less elongated, and usually naked; the eyes are of moderate size,

and the external ears are distinctly developed; the hind legs are the longest, and possess five complete toes, whilst the anterior feet have only four toes and a sort of wart, which represents the thumb; the lower incisor teeth are narrow and pointed; the angle of the lower jaw is rounded, and the clavicles are complete. These animals generally hold their food in their fore-paws whilst they eat it, sitting up on their haunches during this operation. They are all burrowing animals, and most of them swim well.

This family is the most abundant in the order, the species being excessively numerous and very generally distributed in all parts of the world; some are even indigenous to Australia. We have at least eight British species, of which the common Rat (*Mus decumanus*) and the Mouse (*M. musculus*) are only too well known from the depredations which they commit upon our provisions. These, and some other species, of which the diet is not strictly of a vegetable nature, have the molar teeth furnished with plates of enamel or tubercles, which alternate in the teeth of the two jaws; they are thus adapted for their mixed diet. Our common Rat, or Brown Rat, is not indigenous to this country,—and, indeed, its original residence is unknown,—but it is now found in all parts of the world, having been transported in ships along with more welcome merchandise. It is frequently called the Norway Rat, from a mistaken opinion that it was introduced from that country. Its numbers are kept up everywhere by its astonishing fecundity, and its power of subsisting upon any description of food. Wherever it comes it is exceedingly destructive, not only from the provisions it destroys, but from its propensities for burrowing, digging through walls, and gnawing timber, which have occasionally caused the complete destruction of houses. It swims well, and is found in great multitudes in the sewers. When attacked, it is bold and fierce, often flying at a man; and, in fact, its cunning, strength, and ferocity render it a most formidable pest.

The Brown Rat has almost extirpated the true English Rat, or Black Rat (*M. rattus*), which is considerably smaller, but agrees with its rival in most of its habits. Our European Rats are, however, mere dwarfs compared to some of the Indian species, which measure upwards of two feet in length, and are, of course, endowed with a corresponding power of destruction. One of the most noted of these is the *Mus giganteus*,—an inhabitant of the Coromandel coast and some parts of Bengal; it forms its burrows in dry places near houses, and readily digs under the foundations of granaries and through the mud walls of houses in search of provisions. Its principal food consists of seeds of different kinds, but, in default of these, it makes great havoc amongst poultry; the lower castes of Hindoos, to revenge themselves, often feast on its flesh. The Chinese are also said to be great consumers of Rats.

The Field Mice are very abundantly distributed in this country, and furnish a great portion of the food of our smaller predaceous Mammalia and Birds. We have two species of true Field Mice,—the Long-tailed (*M. sylvaticus*) and the Harvest Mouse (*M. messorius*). They are exceedingly destructive in fields and gardens, as they not only devour large quantities of produce, but also lay up considerable stores in the burrows which they prepare for their winter sleep.

The Harvest Mouse is an exceedingly elegant minute species. It forms a beautiful round nest, supported amongst the stalks of the corn plants, in which to rear its young. The nest is made of the leaves of the corn, most ingeniously plaited together.

The Short-tailed Field Mouse (*Arvicola agrestis*) and the Water Rat (*A. amphibia*), with a third British species, belong to the extensive group of the Voles (*Arvicola*),

which are considered by some writers to belong to the same family as the Beavers, to which they are certainly nearly allied. A species of this group, the Ondatra, or Musquash (*Fiber zibethicus*), inhabiting Canada, furnishes a well-known fur; between 400,000 and 500,000 skins of this animal are annually imported into England.

The Hamsters (*Cricetus*) are nearly allied to the true Mice, but are distinguished from them by the possession of cheek pouches. They form complicated burrows, in which they lay up a large store of provisions. They are found principally in the temperate parts of Asia; but one species, the common Hamster (*C. vulgaris*), extends into Europe as far as the Rhine.

The Lemmings (*Myodes*), which are nearly allied to the Voles, are found in the high northern latitudes of both hemispheres. They are remarkable for migrating in immense numbers, in a straight line, from one part of the country to another, generally in the autumn, probably in search of food. They swim well, and never allow themselves to be stopped by any expanse of fresh water, however broad, or any river, however rapid. The best known species is the common Lemming (*Myodes lemmus*), which is very abundant in the mountains of Scandinavia and Lapland. From the sudden appearance of this species in vast crowds, it was formerly supposed to fall from the clouds; and some old writers gravely relate instances of their dropping on the decks of ships at sea, and into the laps of women sitting at their cottage doors. They are exceedingly destructive to the produce wherever they make their appearance.

The Gerbilles (*Merionides*) are principally inhabitants of the continent of Africa, but a few species occur in India. They are placed by some authors amongst the Jerboas (*Dipodidæ*), which they closely resemble in form and habits.

The family of the *Psammoryctidæ*, or Sand-Rats, which is principally confined to South America and the West Indies, agrees in most of its characters and in the habits of the animals included in it with the Muridæ. The limbs are of about equal length, the ears of moderate size, and the tail similar to that of the Muridæ; the angle of the lower jaw is produced into a long point, and the molars, which are almost always four on each side in each jaw, have a flat surface with transverse folds of enamel, and are destitute of roots. They are generally of small size, and live for the most part in burrows in sandy places; but some species inhabit the branches of trees (*Capromys*, &c.) Some genera, such as *Loncheres* and *Echinomys*, have stiff spines mixed with the ordinary hairs on the back, from which circumstance a few of the species have been described as Porcupines.

The *Georhychidæ*, or Mole-Rats, form another family nearly allied to the Muridæ. These singular animals have a stout, elongated, and cylindrical body, with short legs, of which the anterior are stronger than the posterior, and the feet are all furnished with five toes. The head is large and obtuse, and the external ears very small, or entirely deficient; the incisor teeth are broad and truncated at the end, and usually project considerably from the front of the mouth. The eyes are excessively small and often covered by the skin, and the tail, like the ears, is either rudimentary or wanting.

In their general appearance these animals present a close resemblance to the moles; as in these, the form of the body and the structure of the limbs indicate a strictly subterranean existence. They are found in both hemispheres, but the species are not very numerous. The greater part of them occur in Asia, but several extend into the south-eastern parts of Europe. They are exceedingly injurious to agriculture, as they feed upon the roots and under-ground stems of plants.

Several species possess large cheek pouches, in which they carry off great quantities of provisions, and store them away in their subterranean retreats. At the Cape of Good Hope, one species, the *Georhychus capensis*, is so abundant in gardens as to do immense mischief, and in large grounds, according to Dr. Andrew Smith, it is usual for a man to be employed in nothing else than seeking and destroying these animals. Like the Moles they betray their position by the mounds of earth which they throw up. Another Cape species, the Sand-Mole (*Bathyergus maritimus*), which is as large as a Rabbit, is described by the same author as burrowing in sandy localities to such an extent as to render them unsafe to ride over; it is a fierce animal and, when approached, instead of retreating to its burrow, it stands with its mouth open expecting the attack. It bites with such determination that when it has fixed upon a stick it may be carried for some distance before it will quit its hold.

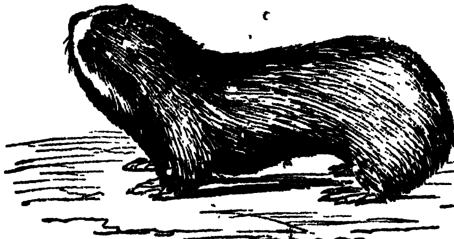


Fig. 356.—The Mole-Rat (*Spalax typhlus*).

The family of the *Chinchillidæ*, or Chinchillas, includes a small number of elegant little animals, which are entirely confined to South America, where the greater part of them inhabit the mountains at a considerable altitude. In these animals the hind feet are considerably longer than the anterior, and the animals, when feeding, always sit upon their haunches and hold the food between the short fore paws. The ears are very large and broad; the tail is long and covered above with long hairs, which form a large tuft at the tip, and the molar teeth are composed of three transverse laminæ of bony matter and enamel, united by cement. The clavicles are complete.

The fur of the Chinchillas is very thick, and of a soft, woolly texture, especially in those species which live at a considerable altitude; it is usually of a gray colour, very elegant in its appearance, and that of some species, especially the Chinchilla (*Eriomys laniger*, Fig. 357), is greatly admired for winter clothing. With one exception, these animals are found upon the Andes, in Chili and Peru. Here they live in societies, retreating into natural cavities amongst the rocks, and only making their appearance on the surface at night. The Mountain Viscacha (*Lagidium Cuvieri*) lives on the plateaux of the Peruvian Andes, always at an elevation of at least twelve or thirteen thousand feet, and usually near the line of perpetual snow. It is a larger animal than the Chinchilla, but its fur is not of so much value. The Viscacha (*Lagostomus trichodactylus*), a species nearly allied to the preceding, inhabits



Fig. 357.—The Chinchilla (*Eriomys laniger*).

the great plains of Buenos Ayres, where it digs burrows for itself; it is the largest species, but its skin is held in no esteem.

Nearly allied to the Chinchillas are the *Dipodidæ*, or Jerboas, in which the hind legs attain an extraordinary development, the metatarsi in particular being very long, so that the little animals hop along like the Kangaroos entirely on their hind legs. The fore legs are exceedingly short, and the feet are furnished with four toes, armed with claws, with which the Jerboas dig burrows, in which they live like most of the species of this order. The clavicles are complete. The hind feet usually consist only of three complete toes, and the metatarsus is often formed of a single bone. The tail is very long, cylindrical, and pilose, the nose is furnished with long bristles, the eyes and ears are usually of large size, and the infraorbital foramen is also very large.

In the general form of their bodies and limbs the Dipodidæ may be looked upon as the representatives of the Kangaroos amongst the Rodentia, but they differ from these Marsupials completely in the way in which they rest upon the hind feet, which only touch the ground with the toes, whilst in the Kangaroos the lower surface of the tarsus is applied to the earth. By means of these powerful elongated hind legs the Jerboas perform most astonishing leaps.

The Dipodidæ are inhabitants of Asia and Africa; a few also occur in the South of Russia, and two in America. They are found in the desert plains of Asia and Africa, and pass the winter in a state of torpidity. They are all small animals, the largest (*Scirtetes decumanus*) not exceeding nine inches in length of body, whilst the smallest (*Dipus monotarsus*) is only three inches and a-half. The ordinary size is about five or six inches, but the tail is often longer than the whole body. The best known species is the Egyptian Jerboa (*Dipus ægyptius*), which occurs abundantly in dry places in the North of Africa, and appears never to drink. Of the American species, one, the Labrador Jumping-Mouse (*Jaculus labradorius*), is very common in the fur countries, and occurs at least as far north as the borders of the Great Slave Lake, in latitude 62° N. In the Eastern Hemisphere no species appears to occur further north than 55° N. lat. The second American species is an inhabitant of Mexico.

The family of the *Myoxidæ*, or Dormice, is evidently intermediate between the preceding more or less mouse-like animals and the true Squirrels, although by many zoologists they are included in the same family with the latter. The principal characters by which the Dormice are distinguished from the Squirrels are derived from the structure of the skull, teeth, and intestine. The form of the skull resembles that of the Mice, in being suddenly narrowed in the frontal region, and the frontal bone is destitute of a postorbital process, which occurs in the Squirrels, and which indicates the separation of the orbit from the temporal fossa. The molar teeth are four on each side in each jaw, and more or less complicated in their structure; and the intestine is destitute of a cœcum, an organ which is of very large size in all the other Rodentia. The posterior legs are a little longer than the anterior, and furnished with five distinct toes; the anterior feet have four perfect toes, and a small nailless tubercle in the place of the thumb. The tail is elongated and clothed with hair, and the ears are of moderate or large size.

The Dormice are active little creatures, closely resembling the true Squirrels in their manners and mode of life. They are found only in the temperate parts of the Old World, especially in Europe and Africa; in Asia they seem to be confined to the neighbourhood of the Caucasus.

Only a single species, the Common Dormouse (*Myoxus avillanarias*), is found in

Britain. It is a small species, less than three inches in length in the body, with a somewhat bushy tail of two inches and a-half in length; its colour is a light tawny above, becoming paler and yellowish on the belly. It lives in woods and thickets, where it builds a small round nest of leaves amongst the branches of shrubs. It feeds on corn, berries, nuts and acorns, and, like the Squirrel, takes its food between its fore paws and sits upon its hind quarters to eat it. During the autumn it becomes very fat and lays up a store of food against the winter season, which it passes in a state of almost total torpidity, only awakening from its long slumber when the weather is particularly mild, taking a little food from its hoard, and then relapsing into its former state of insensibility. When the warm weather of spring rouses it permanently from its lethargy, it has lost the greater part of its autumnal fat. This phenomenon of torpidity appears to be evinced by the Dormouse in a more striking degree than by any other British animal; hence the name of *Sleeper* is frequently applied to it, and most of the European languages have a similar denomination for these animals; even *Dormouse* evidently refers to its habits of sleeping. The habits of the other species, which are not numerous, appear to be very similar to those of our Common Dormouse.

From the Dormice we pass by an easy transition to the *Sciuridæ*, or Squirrels, of which one beautiful species is an inhabitant of Britain. The principal characters by which these are separated from the preceding family have been already stated; they consist in the presence of a fifth small molar in the upper jaw and the simple structure of all the molars; in the existence of a postorbital process on the frontal bone, and of a distinct cæcum. The tail is densely clothed with long hair, and presents a remarkably elegant bushy appearance, especially when the animals carry it over their back, which is the case in many species. The Squirrels are distributed in all parts of the globe except Australia, but their principal residence is in North America. Their food is entirely of a vegetable nature.

The great majority of the species of this family, like our common English species (*Sciurus vulgaris*), are light, active, elegant creatures, living entirely on the branches of trees, where they seek their food, consisting of nuts and other fruits, and the bark and leaves of trees. In eating nuts, they gnaw with the front teeth through the hard shell, and then carefully remove every particle of the skin from the kernel before eating it. The English species, which is too well known to need description, makes a beautiful nest of moss, leaves, and fibres, most ingeniously interlaced; this is placed either in the hole of a tree or on the fork of two branches; but even in the latter case it is generally admirably concealed.

The Squirrels live in pairs, and generally reside upon the same tree for a long period. The female produces her young in June, and these are attended upon most assiduously by both parents, and remain with them until the following spring, when they depart to seek a partner, and settle in the world. Like the Dormouse, the Squirrel lays up considerable stores of food in the autumn, and passes the winter in a state of almost uninterrupted torpidity, except when a fine day rouses it from its slumbers. At this season, in the most northern parts of Europe, the Squirrels acquire a gray fur and they are often killed early in the spring for the sake of this winter coat.

The long bushy tail of the Squirrel serves to keep him warm and comfortable during his winter sleep; but this is not its only office, for in springing from branch to branch the hairs of the tail spread out, and evidently assist in supporting the animal in his progress through the air. He also increases his surface by stretching out his legs on each side of him; but in the Flying Squirels (*Pteromys*) of Southern Asia and its

islands there is a further provision for this purpose, in the shape of a broad fold of skin running along each side of the animal from the fore to the hind legs, by the extension of which it is stretched in such a manner as to form a regular parachute. By this arrangement these animals are enabled to take prodigious leaps, but they always descend, and the name of flight is of course equally inapplicable to this mode of progression, as to that of the so-called flying Phalangers and Lemurs.



Fig. 358.—Flying Squirrel (*Pteromys*).

Our Squirrel, like the other members of his order, undoubtedly commits considerable depredations upon cultivated grounds in his anxiety to provide a sufficiency of food to carry him through the winter; but these can rarely become serious. It is otherwise, however, in the United States of America, where Squirrels abound to an extraordinary extent, and often cause great loss to the farmer by their incursions upon his corn fields. In that country they are accordingly destroyed without remorse by the agriculturists; and so serious were the ravages committed by one species (*Sciurus migratorius*) in the state of Pennsylvania, in the early part of the last century, that a law was passed, giving a reward of threepence for every Squirrel destroyed; at this rate, in 1749, no less than £8000 were paid, representing 640,000 Squirrels destroyed. Some of the East Indian species are also very injurious to agricultural produce.

The Earth Squirrels (*Tamias*), distinguished from the preceding forms by the possession of cheek pouches, differ from them also remarkably in their habits. They dig burrows in the ground, where they lay up a store of provisions, and never ascend the trees except when compelled by want. These animals are found only in Siberia and North America. They are evidently intermediate between the true Squirrels and the Spermophiles and Marmots, which constitute the rest of the family, and which are strictly terrestrial in their habits. The Spermophiles (*Spermophilus*) are distinguished from the Marmots (*Arctomys*) by the possession of cheek pouches; in other respects they are very similar, and exhibit a great contrast to the elegant Squirrels in their heavy forms and short tails. Both genera are equally distributed over a large extent of country, stretching from the centre of Europe through Siberia to North America. They are found in all parts of the last-named continent as far south as Mexico. They generally live in societies in mountainous districts, frequently at a great elevation; here they excavate extensive galleries, in which they reside and pass their long winter sleep. Before passing to their torpid state, they are said to close the mouths of their burrows with a bundle of dry grass, which they drag in after them, so as to exclude the cold air.

The commonest European species is the Marmot (*Arctomys marmota*), which occurs abundantly on the highest of the Alps. Another species, the Bobac (*A. bobac*), is an inhabitant of Poland, Gallicia, and Russia. The latter countries also possess a species of Spermophile (*S. citillus*).

One of the most remarkable species is the Prairie Dog (*A. ludovicianus*), an inhabitant

of the prairies in the neighbourhood of the Missouri. These animals live together in considerable societies, burrowing deeply into the earth, and throwing up the dirt from their burrows into a conical mound, at the apex of which is the entrance. These mounds are usually about eighteen inches in height, and amongst them the inhabitants of the burrows are to be seen moving about with an air of business, which has caused the name of *villages* to be given to their settlements. As has already been stated, these burrows are often taken possession of by a species of Owl (*Athene cunicularia*), and these dissimilar creatures are constantly seen intermixed in the villages. The note of these Marmots has been compared to the bark of a small dog; hence the name of Prairie Dog commonly given to them.

## Order IX.—Pinnipedia.

**General Characters.**—The order of the Pinnipedia, including only the Seals and the Walrus,* is at once distinguished from all other Mammalia by the peculiar structure and arrangement of the extremities. The toes of all the feet are united almost to their extremities by the common integument, by which they are converted into broad fin-like organs, the bones of the arm and leg being usually short, and concealed, to a great extent, beneath the skin of the body. The tips of the toes are armed with strong claws, and these are frequently almost the only indication of their existence, although the bones are the same as those of the most perfectly-organized Mammalia. The position of the hind feet is very remarkable; they are placed quite at the hinder extremity of the body, and thrown backwards into a nearly horizontal position on each side of the very short tail, so as to resemble the horizontal tail of the Whale, and, like this, they constitute the principal agents in the locomotion of the animals in their natural element the water, where they swim and dive with the greatest facility. When swimming, the fore-paws are applied close to the side of the body, and are only used in turning about.

The general form of the body is particularly adapted for a residence in the water, being nearly cylindrical, and tapering gradually from before backwards; the neck is short, and the head small and rounded. Like the Cetacea, which they resemble in their general form, the Seals have the surface of the body covered with a stratum of blubber, which serves the same purposes as in those Mammalia. The skin, however, is covered with hair of two kinds,—a soft woolly down, close to the skin, and a coat of long smooth hairs, which lie close to the body, and form a shining coat, offering no resistance to their passage through the water.

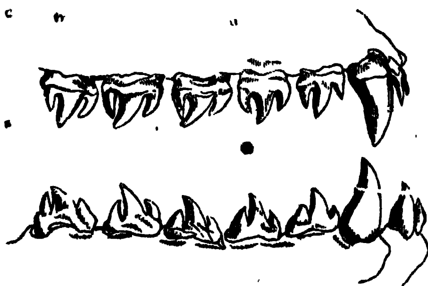


Fig. 359.—Teeth of the Seal (*Stenorhynchus*).

The skull and jaws are compact and powerful, and the former exhibits strong ridges for the attachment of the muscles of the jaws. The orbits are usually continuous with the temporal fossæ. The teeth are always of three sorts, but they vary considerably in number. The incisors are usually small, but the canines are large and powerful, curved and sharp at the point, indicating the carnivorous nature of the animals. A further evidence of this

is furnished by the form of the molar teeth, which are remarkable for being usually furnished with only a single root; their crowns are strongly compressed laterally, with sharp cutting edges, which are usually more or less notched, and sometimes (Fig. 359) deeply cleft, so as to form three or more distinct points.

The mouth is furnished with thick fleshy lips, from which spring numerous long bristles. The tongue is smooth. The nostrils are placed at the front of the snout, and are capable of being completely closed when the animal is under water. The external ears are usually represented by a small valve, which closes the aperture under the same circumstances. The eye is large, full, and expressive of great intelligence, a quality which is exhibited by these animals in a very high degree; and the brain, as might be expected from this circumstance, is of large size, and of a very high type of organization. The mammæ are usually only two in number, and placed far back; the female produces a single young one, and attends to it with great assiduity. Their voice is usually a kind of bark, whence the name of Sea Dogs applied to them in some countries.

The habits of all the animals of this order are very similar. They live in the sea, but always in the neighbourhood of the coasts, where they wage an incessant war upon the fishes, which constitute the principal food of all with the exception of the Walrus. They are not, however, like the Cetacea, entirely confined to the water, but can easily climb upon the low rocks, where they are exceedingly fond of lying in herds basking in the sun. When thus engaged they are exceedingly watchful, and plunge into the water the moment any danger approaches them. On shore, as might be expected from the structure of their feet, their movements are anything but elegant; they are performed by the action of the strong muscles of the back; the creatures hold by their fore paws, whilst they curve the back strongly, and thus draw forward the hind feet; the latter then form the point of support, and the head and fore paws are pushed on by the straightening of the body. This mode of progression is evidently very laborious, and the Seals never travel to any distance on land.

**Divisions.**—The Seals are not very numerous, and they only form two families, of which one is formed by the true or typical Seals (*Phocidæ*), whilst the second (*Trichecidæ*) includes only the Walrus, a most aberrant form, which evidently leads from the true Seals towards the herbivorous Cetacea.

The *Phocidæ*, or Seals, exhibit the typical characters above described in the greatest perfection. They are distinguished from the following family by the possession of incisor teeth in both jaws, and by the moderate size of the canines. The molars are sharp-edged, and either simple or notched; in the latter case they are usually furnished with two roots. An external ear is present only in one genus (*Otaria*), the species of which inhabit the Southern Ocean.

The Seals are for the most part confined to the seas of the extreme northern and southern parts of the world, abounding especially around those coasts which approach most closely to the two poles. Of the northern species, four have occurred on our shores. Of these, however, only one, the Common Seal (*Phoca vitulina*), appears to be at all abundant, the others being either confined to particular localities, or represented by occasional individuals which may have strayed from the cold northern regions. The Common Seal is abundant on the coasts of Scotland and the Scottish islands, but further to the south it is less common. It measures from three to five feet in length, and is of a yellowish-gray colour, with brown and blackish spots on the head and upper surface. It occurs in vast profusion in the northern seas, both on the European

and American coasts; and as both its skin and the oil prepared from its fat are exceedingly useful, its capture is a matter of no small commercial importance, and immense numbers are killed annually in the northern seas. The oil is excellent for burning in lamps and the skin is either tanned, or deprived of the long outer hair, and used as fur. To the Greenlanders and other northern people the Seal is still more valuable; its flesh furnishes them with the greater part of their food; its skin constitutes their principal clothing, and serves to cover their boats and huts; its tendons are the threads with which the skins are sewn together, and the thin skin of the intestines is used instead of glass in windows. In captivity the Seal is very docile, and exhibits considerable attachment to man and a great share of intelligence. It may be taught many tricks, and will perform them in obedience to the word of command.


Fig. 360.—The Harp Seal (*Phoca Grœnlandica*).

The Harp Seal (*Phoca Grœnlandica*, Fig. 360) is another species which has occasionally been seen on the British coasts. It is a larger species than the Common Seal, usually measuring about six feet in length. It is of a gray or grayish-white colour, with the face and a broad lunate mark on the back and sides black. When quite young, however, it is snow-white, and in this state its fur is highly prized. The Harp Seal is especially abundant on the coasts of Greenland, where it almost always frequents the floating ice, and rarely ventures upon the shore or on the shore ice. It is, perhaps, the most important species to the Esquimaux of Greenland.

One of the largest species is the Great Seal (*Phoca barbata*), which measures eight or ten feet in length. Like the preceding, it is found principally amongst icebergs in the open sea, and its skin is highly esteemed. It has been found on our northern coasts.

Another large species is the Gray Seal (*Halichœrus gryphus*), which measures eight or nine feet in length. It is abundant on the coasts of Iceland, and all round the Scandinavian peninsula; and from Mr. Ball's statements it would appear to be a constant resident on the Irish coasts. The old males are exceedingly quarrelsome, and bite each other severely in their contests. A peculiar species of Seal (*P. Caspica*) is found in the Caspian Sea, and probably also in the two great lakes, Aral and Baikal, in Siberia. It is about the size of the Common Seal, and affords an excellent oil, for the sake of which upwards of twenty thousand are killed annually in the Caspian alone.

In the genus *Stenorynchus* the molar teeth have the crowns notched, so that they exhibit from three to five more or less distinct points; they are usually furnished with two roots. These animals are peculiar to the Southern Ocean, with but one exception, the Monk Seal (*Stenorynchus monachus*), which inhabits the

Mediterranean. This is a very large species, measuring from ten to twelve feet in length.

In the genus *Cystophora*, the nose of the male is furnished with a singular appendage, which is capable of being inflated at the will of the animal. It includes only two species, one of which is a native of the Arctic and the other of the Antarctic Seas. In the latter, the Sea Elephant, or Bottle-nosed Seal (*C. proboscidea*), the nose is capable of being protruded into the form of a proboscis of nearly a foot long, which gives the creature a most singular appearance. It is an enormous animal, often measuring twenty-five feet in length, and, according to Peron, sometimes no less than thirty. It is, however, of a peaceful disposition, so that men may go about amongst its herds with perfect safety. It is found about the shores of desert islands in the great Southern Ocean, and also on both coasts of Patagonia; and as it furnishes an excellent oil, it was at one time the object of a most active pursuit, as many as forty thousand of these animals being killed annually on the South American coasts in the early part of the present century. The natural consequence of this reckless destruction has been the almost complete extinction of the Sea Elephant in many places where it formerly abounded. In the northern species, the Hooded Seal (*C. cristata*), the nasal appendage forms a sort of hood, which reaches to the back of the head.

The Eared Seals (*Otaria*) are found principally in the southern Seas, although some of the species extend to the northern parts of the Pacific Ocean. To this group belongs the Sea Lion (*O. jubata*) and the Sea Bear (*O. ursina*). The latter is called the Fur Seal, as its skin furnishes that soft yellowish fur which was formerly so much in use for making caps and waistcoats. It was at one time excessively abundant about the Falkland Islands, and many other islands of the great Southern Ocean, but the numbers killed by the hunters, and the indiscriminate mode in which the chase was carried on, soon nearly extirpated the animal. The larger males are about seven feet long; the females much smaller; its general colour is grayish.

The Walrus (*Trichecus Rosmarus*) which alone forms the family *Trichecidæ*, differs in several important characters from the true Seals. It appears, in fact, as stated by Von Baer, to be a transition from the Cetacea, with some of the peculiarities of the Pachydermata. The skull is large and heavy, and the facial portion much more elongated than in the true Seals; the nose especially is broad and obtuse. There are six incisor teeth in both jaws in very young animals, but during growth the whole of these fall out, with the exception of two in the upper jaw. The upper canines are enormously long, forming a pair of large pointed tusks which pass downwards between the small canines of the lower jaw, and project a considerable distance below the chin. The molars are very variable in number, as they fall out in proportion as the animal increases in age, so that when mature, it possesses fewer of these teeth than in its earlier years. They are of a conical form, but worn away in an oblique direction at the apex. The body of this animal is exceedingly bulky, but it resembles the Seals in its general form and in the position of the legs. It is said sometimes to attain a length of twenty feet, and a weight of at least as many hundred weights. The skin is covered with a short brown hair.

The Walrus, Morse, or Sea-Horse, as it is often called, is an inhabitant of the Arctic portions of both Hemispheres, and its distribution presents some remarkable peculiarities. Thus it is found in two districts separated from each by many degrees of longitude, and is so entirely confined to these that there are no instances of its being met with in the intervening space. One of these regions includes the Sea of

Kamtschatka, and a space of ten or fifteen degrees on each side of it, on the north coast of both Asia and America; the other is more extensive, reaching from the mouth of the Yenisei, on the north coast of Siberia, westward as far as Baffin's Bay and Prince Regent's Inlet. Their northern limit is about 80° N. lat., and they occurred formerly on the east coast of North America, in the Gulf of St. Lawrence, in latitude 47° N. Stray specimens occasionally visit Iceland, and still more rarely the Scottish coasts. It is most abundant in the first mentioned district, but also occurs in profusion on the shores of Spitzbergen and Nova Zembla, where, as in many other places, it is hunted for the sake of its oil and tusks. The latter are often two feet in length and furnish a beautifully white, hard ivory. The Morses are killed when reposing on the shore, which they often do in large herds; the hunters get between them and the sea and thus cut off their retreat. The tusks are employed by the Walrus not only in defending himself from his enemies, but also principally to assist him in climbing on the ice. The food of this animal appears to consist chiefly, if not entirely of sea-weeds, which affords a further evidence of its relation to the herbivorous Cetacea. Its flesh is eaten, but the accounts of voyagers differ materially with regard to its qualities, some describing it as good, others as just the contrary, and according to Mr. Fisher, the astronomer in two of the northern voyages, it smelt so abominably that the dogs on board would not touch it.

## Order X.—Carnivora.

**General Characters.**—In the preceding order we had examples of animals adapted for a predaceous resistance exclusively in the water, those constituting the present order are almost as exclusively terrestrial or arboreal in their habits, and although some, such as the Otters, prey upon fishes, their feet are still adapted for walking, and they are not reduced to the same ungainly mode of progression as the Seals. The Carnivora, therefore, are true quadrupeds.

The teeth are somewhat variable in form, but generally, as in the Pinnipedia, the molars show by their compressed form, and sharp cutting edges that they are intended for the division of flesh. All three kinds of teeth are always present. The incisors are small, six in number, and placed in a transverse row across the front of the mouth; the canines are always of a large size, conical, curved, and acute, especially in the most decidedly carnivorous species, where they are so long that there is usually a gap between the incisors and canines in the upper jaw, for the reception of the lower canine. Behind the canines each jaw bears several false molars, the foremost of which are usually conical and inserted by a simple root. The hinder ones gradually approach the form of the true molar, which is more or less compressed, sharp, and notched at the edge;* this is commonly known as the *flesh tooth*. Behind it there are often one or two small tubercular molars. In the Cats and the most bloodthirsty species in general, the false molars are compressed and sharp, and the total number of molars is often reduced to three, which are all inserted by two or more roots, much compressed, and furnished with very sharp jagged edges, fitting against one another like the blades of a pair of scissors, an arrangement admirably adapted for cutting through the juicy fibres of the flesh of their victims. In proportion as the animals are intended for a mixed diet, the molar teeth become broader, and more tuberculate in their appearance; this may be seen even in the common Dog. To give effect to these sharp, cutting teeth, the lower jaw in the typical Carnivora is articulated to the skull by a regular hinge joint (as already described, p. 377), and the transverse position of the condyle is distinctly perceptible

even in the less rapacious species, although to a certain extent modified. The ascending ramus of the lower jaw, which gives attachment to the muscles by which the jaws are closed, is always very large, especially in the typical species.

The skull and face are short and compact; the former is usually marked with very strong ridges, for the attachment of the muscles of the lower jaw, and the zygomatic arches are very wide to allow of their passage. The orbits are incomplete. The brain and organs of sense are always well developed; the nose especially, in many species, exhibits a greater degree of perfection, than in any other animal. The eyes are usually large and full, and the pupils possess a great power of contraction and dilatation to adapt the creatures for their generally nocturnal mode of existence. Nearly all the species possess a distinct external ear. The mouth is surrounded with soft lips, from which long whiskers project on each side; these are supplied with nerves, and evidently constitute delicate tactile organs. The tongue is always long, thin and free, and the animals drink by the well known process of lapping. The mammæ, which are always placed on the belly, are usually numerous, and many of the animals are very prolific. The young are always born blind.

The form of the body, the development of the tail, the length of the legs, and the structure of the feet, vary greatly in the different families of this order. The toes are distinctly divided, and armed with claws; they are usually five in number on the anterior, and four on the posterior feet, and none of them are ever opposable. The principal peculiarities in the construction of the feet have reference to the mode in which they are applied to the ground, and as this is in direct connection with the habits of the animals, and always corresponds with other important characters, the differences observed in the structure of the extremities, are of great value in the discrimination of the families, and have even been employed in the primary division of the order into groups. The most predaceous species are possessed of extraordinary activity; their bodies are light and muscular, their legs are long, and their short toes alone are applied to the ground; they walk, as we should say, on tip-toe, and they are accordingly called *Digitigrada*. Those species which are intended for a more or less vegetable diet, are heavier and endowed with far less agility; their toes are longer, and they apply the whole foot including the metatarsus and tarsus to the ground in walking; these are denominated *Plantigrada*. These two groups, however, shade off almost insensibly into one another, and some naturalists have proposed the formation of an intermediate group, containing those Carnivora in which a portion of the sole is applied to the ground, under the name of *Semi-plantigrada*.

**Divisions.**—The first of the above groups, the *Digitigrada*, includes the most typical members of the order. The first family is that of the *Canidæ*, or Dogs, in which the head is more or less conical and pointed in front, from the jaws being somewhat produced, and the legs are of equal length, the anterior furnished with five, and the posterior with four toes, all armed with non-retractile claws. The dentition is complicated. There are three false molars on each side in the upper, and four in the lower jaw; these gradually increase in size posteriorly, and approach the true molar in form. The latter is very large, compressed, and cutting, and is followed in both jaws by two small tubercular teeth; the total number of molars is thus, $\frac{6-6}{7-7}$. The tongue is soft and destitute of horny spines.

Of this family our Domestic Dog, (*Canis familiaris*), is an excellent example. The domestication of this invaluable animal is undoubtedly the greatest triumph of which

man can boast over the brute creation; in all his faculties, both of body and mind, he has become more completely subservient to his master than any other animal, and without his assistance it seems pretty certain that the dominion of man over many of the common domestic animals, would never have been so complete as it now is. All the strength, courage, and intelligence which the Dog possesses, are willingly put forth in the service of his master; to use the words of Professor Bell, "It is in the Dog alone that we find those qualities which fit him for that more intimate association with his conqueror, by which he becomes his friend and companion, whilst still his faithful and humble, and laborious servant," and as the same author adds, "it is impossible to reflect without the most kindly and grateful emotions, on the unwearied perseverance, the unflinching courage, the unchanging faithfulness, the affectionate and discriminating attachment, which characterize his relation to mankind." As it would be impossible in the limited space to which we are necessarily confined, to give any but the most hacknied account of the history and habits of the different races of this noble animal, we shall merely refer to the fact, that although wild races of Dogs have been found in different parts of the world, it is supposed that these are merely the progeny of stray tame individuals, and the original stock of the Dog is still unknown. These wild Dogs however, as well as several of the breeds found half-reclaimed amongst some savage nations, exhibit a very marked resemblance to the Wolf (*Canis lupus*), and many naturalists are of opinion that all our varieties of Dogs owe their origin to that savage animal.

The osteological structure of the Wolf and the Dog are identical, and what is a still more important point their period of gestation is exactly the same (sixty three days), so that improbable as it may at first sight appear, there is no such great difficulty in the way of the supposition of their specific identity. The general opinion of the complete intractability of the Wolf is certainly without foundation; this animal exhibits a good deal of the sagacity of the Dog, and there is at all events, one instance on record of his showing as great a regard for his master as the most faithful and affectionate of the domestic varieties of the Dog.

The Common Wolf was formerly an inhabitant of this country, but has now been extinct for many years. It still occurs, however, in all the unfrequented parts of the Continent of Europe, and the north of Asia, residing principally in the mountain forests, whence it frequently descends upon the inhabited districts and commits great ravages amongst domesticated animals of all kinds. It is about the size of a large dog, but leaner and more gaunt in its appearance; its eyes have a peculiar obliquity, which give it anything but an agreeable expression of countenance. As in the domestic Dog, the pupils of its eyes are round, and it always hunts its prey in packs, at least when the object of pursuit is of large size. Several distinct species of Wolves are found in different parts of the world, but they all resemble the Common Wolf in their habits. One of the finest species is the North American Black Wolf (*Canis nubilus*).

The Jackal (*Canis aureus*) is another well-known species of this family, which, like the Wolf, hunts its prey in packs. It is a nocturnal animal, lying concealed in holes during the day, and uttering the most horrible yells during its nocturnal peregrinations. It feeds freely on carrion of all kinds, and is thus, like the Vultures, of no little service to the inhabitants of the warm countries, where it dwells, in the removal of nuisances. The common Jackal occurs in all parts of the South of Asia and North Africa; the Cape of Good Hope is inhabited by another species, the Black-backed

Jackal (*C. mesomelas*). The Jackal is often seen in attendance upon the Lion, and it has always been a common belief that he ran down the prey for the so-called King of Beasts, and received a small share of it for himself. The truth is, however, that the Jackal only follows the Lion in order to make a meal upon his leavings.

The Fox (*Vulpes vulgaris*), the only wild British species of this family, is too well known to need description. It is the type of a second section of the family, in which the pupils are elliptical when contracted. It is solitary and nocturnal in its habits, and lies concealed during the day in its burrow, which it either excavates for itself or takes by force from some other burrowing animal, such as the Badger or Rabbit. Rabbits, Hares, and Partridges constitute its favourite food, and it also frequently makes a nocturnal incursion into the farm-yard, where it commits sad havoc amongst the poultry. When poultry and game are not to be had, the Fox will content himself with small animals of any kind, not even disdaining worms and insects; when he resides near the coast, he will resort to the beach to feed on Mollusca and Crustacea, and some of the old naturalists give a ludicrous account of the Fox putting his tail into the water to catch Crabs. In its character the Fox is excessively cunning, and in fact has been proverbial for this quality from a very early period. Its appearance corresponds exactly with its character, and the common proverb which adopts the Fox as the emblem of slyness and cunning is certainly far happier than that in which the Lion figures as the symbol of courage and magnanimity. Fox-hunting is to be regarded as the national sport of this country, and in a hunting district it would be regarded as an act of the most heinous nature to kill one of these animals, except with the assistance of a large pack of dogs and a posse of huntsmen. But for this protection the Fox would doubtless, like the Wolf, have been long since extinct in England.

The numerous foreign species of Foxes all resemble our common Fox in their habits and appearance. The Arctic Fox (*Vulpes lagopus*), however, appears to possess less cunning than most of the other species, for, according to Sir John Richardson, they will stand by whilst the trap is being prepared for them, and walk straight into it as soon as the hunter has left it. This animal is peculiar to the Arctic portions of North America, where it is exceedingly abundant. During the summer it is of a blackish-brown colour, but on the approach of winter the coat becomes white, and excessively long and thick, forming a most admirable protection against the extreme cold which prevails in those high northern latitudes. In this dress the Arctic Fox is an exceedingly beautiful little animal. It is destitute of the disagreeable smell usually evolved by the Foxes and its flesh, when young, is said to be very good.



Fig. 361.—The Arctic Fox (*Vulpes lagopus*).

Africa possesses several species allied to the Foxes, in which the ears attain a great

size. One of these is the Fennec (*Megalotis zerda*) of Egypt and Nubia, and another the *Otocyon Lalandii* of the Cape of Good Hope. The Cape is also inhabited by a very singular species of Dog, which evidently forms the passage from the present family to that of the Hyænas. This is the so-called Cape Hunting Dog (*Lycaon pictus*, Fig. 362), which resembles the true Dogs in its dentition, but exhibits a tendency to sink in the hind quarters, and has only four toes on all the feet,—both characters which indicate an approach to the Hyænidæ, with which, in fact, it has been included by some zoolgists. It is about the size of a good large Dog or small Wolf; its ground colour is a sort of reddish or brownish yellow, curiously mottled and patched with black and white. It is a fierce and active animal, and as it occurs in great abundance on the frontiers of the Cape settlements, and always hunts the larger animals in packs, it does immense damage to the sheep, and even cattle of the colonists. It appears to have an epicurean fancy for Ox-tails, as it will steal down upon the cattle when they are asleep, and bite off their tails. It is said to stand somewhat in awe of the hoofs of Horses, but yet often inflicts such injuries upon them as they cannot survive. In captivity it appears to be one of the most intractable of animals.

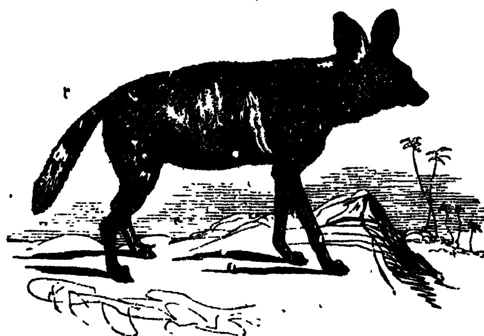


Fig. 362.—Cape Hunting Dog (*Lycaon pictus*).

The second family is that of the *Felidæ*, or Cats, the most typical forms of the order, in which the predaceous disposition, and the means of gratifying it, are developed in the highest degree. In these animals the head is short and almost rounded in its form, for although the zygomatic arches and ridges are greatly developed, the muscles for moving the jaws are so exceedingly large as to fill up all the cavities, and produce a smooth plump surface. The jaws are short, and the dentition is—Incisors, $\frac{6}{6}$; Canines, $\frac{1-1}{1-1}$; Præ-molars, $\frac{4-4}{2-2}$; Molars, $\frac{2-2}{1-1}$. The canines are long, sharp, compressed, and cutting; the præ-molars are furnished with two roots, compressed, pointed, and serrated; the flesh teeth or true molars are very large, sharp-edged, and terminated by two or three points; and behind the flesh tooth in the upper jaw there is a small tubercular tooth, which is wanting in the lower jaw. In addition to this formidable apparatus of cutting teeth, the tongue in these animals is covered with small recurved prickles, with which the Cats are enabled to lick the last particles of flesh from the bones of their prey.

In the form of their bodies the Cats are all light, and excessively muscular, so that their activity is most astonishing. Their legs are usually of moderate length, but exceedingly powerful, and the toes are armed with long, curved, and acute claws, which are preserved from being blunted by a peculiar arrangement of the phalanges.

For this purpose, the last or claw joint of each toe is drawn back, by ligaments attached to the penultimate joint, until it assumes a perpendicular position, when the claw which it supports is completely retracted within a sort of sheath, and is entirely concealed by the fur. This is effected by the elasticity of the ligaments, and without any exertion on the part of the animal. But when a Cat is about to strike its prey, the claw joint is pulled down by the flexor muscles, and the formidable talons are then protruded, ready to be buried in the flesh of the victim. The lower surface of the foot is furnished with thick ball-like pads of the epidermis, upon which the animal walks, and these are the cause of the peculiarly noiseless tread which is characteristic of all the members of this family. They always take their prey by springing suddenly upon it from some concealed station, and if they miss their aim in the first attack, rarely follow it up. They are all accordingly cowardly, sneaking animals, and never willingly face their enemy unless brought to bay or wounded, trusting always to their power of surprising their victims by the aid of their stealthy and noiseless movements. They are nocturnal and solitary in their habits, or at most live in families. They are distributed in all parts of the world, with the exception of Australia, but principally in the warmer regions, where alone the larger species are met with.

Unquestionably the most celebrated species of this family is the Lion, which has in all ages been regarded as the personification of courage and magnanimity. For his reputation he has, however, been mainly indebted, like many other impostors, to his noble appearance, which is greatly owing to his possession of a large mane of long hairs; in his habits he is as genuine a Cat as the Tiger, with whose bloodthirsty and cruel disposition the supposed good qualities of the Lion have been so frequently contrasted. Zoologists have described several species of Lions, forming the genus *Leo*; they are distinguished from the other Cats by their tufted tails, and by the uniform colour of their skin. The best known species is the African Lion (*Leo Africanus*), which enjoys a wide distribution, extending all over the continent of Africa, and into the southern parts of Asia. It is a magnificent species, generally furnished with a long flowing mane in the male; the other supposed species differ principally in the development of this appendage, and in one, the Maneless Indian Lion (*L. goojrattensis*), the mane is quite absent. It must be confessed, that the specific distinctness of these different forms of Lions is very doubtful. The Lion lives principally in dry desert tracts of country covered with brushwood, amongst which he lies during the day, and prowls about at night in pursuit of the large herbivorous animals, generally watching for them at the places where they come to drink. In stormy nights, the South African Lion is said to be particularly active, as the panic produced amongst his victims by the strife of the elements renders less caution necessary in approaching them.

In the typical genus *Felis*, the tail is elongated, but destitute of a tuft, and the skin is almost always marked with stripes or spots. These animals are mostly inhabitants of the forests, where many of them climb trees, not only in pursuit of birds and other arboreal creatures, but also for the purpose of springing down from the branches upon animals that may pass beneath them. The finest species of this group is the Tiger (*Felis tigris*), which equals the Lion in size, but exceeds him in activity. His appearance, from the absence of the mane, is not so noble as that of the Lion; but the bright tawny colour of his skin, with its clear stripes of black, render him one of the most beautiful of quadrupeds. The Tiger is exclusively an inhabitant of the south of Asia.

The Leopard (*Felis Leopardus*) is a smaller species than the Tiger, but equally

beautiful in appearance, his skin being of the same bright tawny hue, most elegantly marked with circles of black spots. The Leopard exhibits some variations, which have led to its separation into two or more species; but these appear to rest upon a very slight foundation, and there is scarcely any difference to be found between specimens of Leopards from the most distant localities. It is very widely distributed, being found in all the tropical parts of the Old World. In America its place is taken by the Jaguar (*Felis Onca*), which resembles it in colour and the general arrangement of the spots but is intermediate in size between the Leopard and the Tiger, and of a stouter



Fig. 368.—The Leopard (*Felis Leopardus*).

form than either. The Jaguar is distributed throughout the warmer parts of the continent of America, although in the more inhabited districts it is now nearly extinct. It is an exceedingly active and powerful animal; like the Leopard it climbs trees well, and can also swim with ease across rivers, in the neighbourhood of which it is generally met with. It is said to carry off a Horse or a Bullock without any difficulty. Another large American species is the Puma (*F. concolor*), which is remarkable in this genus for the uniform dun colour of its skin. It is more widely dispersed than the Jaguar, extending its range into the temperate countries of both North and South America. The Puma is smaller and less powerful than the Jaguar, and is of a milder and more cowardly disposition than most of the larger Cats.

Besides these large Cats, both hemispheres possess numerous smaller species, such as the Ocelots of the New and the Clouded Tigers of the Old World; these are generally marbled or clouded with streaks and spots of black upon a light ground. These, like our Wild Cat (*F. catus*), the only truly British species of this family, are all inhabitants of wooded places, where they frequently ascend the trees. The Domestic Cat is not descended from the European Wild Cat, and its origin is still a matter of dispute. M. Rüppell has discovered a species of Wild Cat in Nubia (*F maniculata*), which closely resembles the domestic breed of the ancient Egyptians; and he considers it probable that all our Cats may be derived from this species. This cat, however, presents several characters of some importance, in which it differs from the Domestic Cat, and the question cannot be regarded as set at rest by M. Rüppell's discovery.

The Lynxes differ from the ordinary Cats in the shortness of their tails, and the possession of pencils of hairs at the tips of the ears. They are rather small Cats, which feed principally on birds and small Mammalia, in pursuit of which they often climb to the tops of high trees. Several species are found in the northern parts of both hemispheres, in Canada, Sweden, Russia, and Siberia; these are coated with a long thick fur, which is in considerable request. The exact number of these northern species does not appear to be very correctly ascertained; they are all of a gray or reddish-gray colour. A nearly allied form is the Caraçal (*Felis caracal*), which is evidently the Lynx of the ancients, and enjoys an equally wide range with the Leopard.

Besides these we have a group of Cats in which the legs are rather long, the body long and slender, the head small and rounded, and the skin simply spotted, such as the Serval (*F. serval*) and the Chaus (*F. chaus*), both natives of Africa. These seem to lead from the true Cats to the remarkable Cheetah, or Hunting Leopard (*Cynailurus jubatus*), in which the claws are but slightly retractile, and which, in its docility and some other respects, appears almost intermediate between the Dogs and the Cats.

In size the Cheetah is inferior to the Leopard, which he somewhat resembles in general form, although he is of a more slender make, and supported upon much longer legs. His skin is not so sleek as that of the generality of Cats; it is of a light yellowish fawn colour above, and white beneath, and the back and sides are covered with a number of black spots, which, however, are not arranged in rings as in the Leopard and Jaguar. The tail is long and usually curled at the extremity. The Cheetah is found in all the warm parts of the Old World, from the Cape of Good Hope to India and the islands of the Indian Ocean, but it is only in India and Persia that it appears to be trained for the purpose which has obtained it the name of the Hunting Leopard. In these countries they are employed in hunting Antelopes; they are taken into the field chained and hooded, in a cart, and when the game is in view they are taken out and set at liberty, the keepers carefully directing their attention to their intended victims as soon as the hoods are removed from their eyes. They then steal towards the Antelopes with all the characteristic caution of the Cats, until they have nearly reached their unsuspecting victims, when they execute five or six tremendous bounds with inconceivable velocity, spring at once upon their terrified prey, bring it to the ground, and sate themselves with its blood. The keepers then approach, coax the Cheetah to leave his victim by caressing him and throwing him pieces of meat, when he is again hoodwinked and chained in the car. The Cheetah appears to be perfectly aware that he is no match for the Antelopes in speed, for if his quarry escapes his first attack, he never attempts to pusue, but returns to his master with a dejected air. In confinement the Cheetah never exhibits the ferocity usual with all the larger and most even of the smaller cats, and in fact in its general disposition presents a certain resemblance to the Dogs.

The *Hyænidæ*, or Hyænas, form a remarkable group, peculiar to the warmer regions of the Old World, which evidently unites the two preceding families with the following one. In the general form of the body they somewhat resemble the Dogs, whilst in their dentition they rather approach the Cats, and they resemble the Viverridæ in the possession of a pouch under the anus. The teeth are—incisors $\frac{6}{6}$, canines $\frac{1-1}{1-1}$, praemolars $\frac{3-3}{3-3}$, molars $\frac{2-2}{1-1}$, the hindermost molar in the upper jaw being tubercular, like that of the Cats. The hind legs are much bent, so that the hind quarters

of the Hyænas are always lower than the shoulders; the feet are all furnished with four toes, armed with strong claws, which, like those of the Dogs, are not retractile. The tongue, as in the Cats, is roughened with prickles.

The chief residence of the animals of this family is on the Continent of Africa, and principally at its southern extremity; only a single species, the common Striped Hyæna (*Hyæna striata*), being found beyond that limit. They pass the day in caves, or in holes which they dig in the ground with their powerful fore feet. At night they come forth in search of their food, which consists partly of the flesh of animals which they run down in packs, and partly of carrion; the common species, as is well known, constantly frequents cemeteries, where it digs up recently-interred bodies for its disgusting repasts. Their jaws and teeth are enormously strong, and capable of crushing the most solid bones; when they bite they hold on obstinately, and it is with difficulty they can be made to let go their hold. The voice of the Striped Hyæna, under circumstances of excitement, resembles a most unearthly laugh, whence the animal is commonly known as the "Laughing Hyæna." When heard at night in the places frequented by these animals, it is no wonder that this sound produced a supernatural effect on the fertile imaginations of the Orientals, and there is no doubt that the grave-yard demons or Ghools of the Arabian mythology are merely exaggerated representations of the Hyæna. Amongst the ancient Greeks and Romans we find somewhat similar notions prevailing with regard to the Hyæna,—it is described by Pliny as imitating the language of men, to induce them to approach it, that it might make a meal of them more conveniently. Notwithstanding the general opinion of the irreclaimable ferocity of the Hyæna, it has occasionally been tamed, and would then follow its master about and fawn upon him like a Dog. The Spotted Hyæna (*H. crocuta*) of South Africa, also, is frequently domesticated, and behaves very much like a Dog. This animal is exceedingly common in the neighbourhood of the Cape of Good Hope, where it commits great ravages amongst the cattle; and in the Kaffir country, where they are very numerous, they often break into the huts of the natives and carry off the young children. The bones of a species of Hyæna, nearly allied to these, but of the size of a Bear, have been found in some caves in Britain, together with those of herbivorous animals with the marks of the Hyæna's teeth upon them, thus proving that at a recent (geological) period this island must have been inhabited by a very large species of this genus. This Hyæna is called *H. spelæus*, or the Cave Hyæna.

The *Proteles Lalandii*, the Aardwolf, or Earthwolf, also a native of the Cape, is considered by some authors as uniting the Hyænas with the Dogs, by others with the Civets (*Viverridæ*). Like the Dogs, it has five toes on the fore feet, and in its general form it is certainly intermediate between the typical Hyænas and the Dogs, but its dentition agrees with the former. It is about the size of a Fox, of a yellowish-gray colour, with transverse black stripes on the sides.

With the Hyænas we quit the series of true Digitigrade Carnivora; in the two next families the animals apply a portion of the sole to the ground, but the heel is always raised; these form the section of the *Semi-plantigrada*. The first family of this group is that of the *Viverridæ*, or Civets, which are evidently very nearly allied to the Hyænas. The teeth in this family are—incisors $\frac{6}{6}$, canines $\frac{1-1}{1-1}$, premolars $\frac{3-3}{4-4}$, molars $\frac{3-3}{2-2}$. The canines are large and sharp; the false molars conical and pointed; the flesh-tooth is large and sharp, and furnished with an inner process; and behind it

are two tubercular molars in the upper and one in the lower jaw. The tongue, as in the two preceding families, is prickly. The body is elongated, and supported upon short legs, which have either four or five toes on all the feet, furnished with semi-retractile claws; the muzzle is produced and sharp, the tail very long and tapering, the hair coarse, and in the neighbourhood of the anus there is a glandular pouch, which secretes a strongly odorous matter. This substance, well known as *civet*, was formerly in great repute both as a medicine and as a perfume, as indeed it still is in many of the countries inhabited by these animals; and even here we find the Civet Cat, as it is called, still holding its traditional post as the sign of perfumers' shops.

With the exception of one species, the *Bassaris astuta*, a native of Mexico, the Civets are all inhabitants of the warmer parts of the Eastern Hemisphere. They are nocturnal in their habits, and the pupil contracts into a linear form when exposed to the light; in their disposition they are generally savage and bloodthirsty, and they make great havoc amongst the smaller animals, particularly birds, of which and of their eggs they are remarkably fond.

The true Civet (*Viverra Civetta*, Fig. 364) is a native of North Africa, in some parts of which it is kept for the sake of the perfume which it affords; this is collected two or three times a-week, the animal, whose teeth are justly dreaded by his owners, being placed in a very narrow cage, whilst his anal pouch is being cleared out with a spoon or spatula. Another species, the Rasse (*Viverra Rasse*), or Javanese Civet, is treated in the same way by the Javanese.



Fig. 364.—The Civet (*Viverra Civetta*).

Whether the ferocity of the above species is caused by their anxiety about the safe-keeping of their secretions we cannot of course tell, but it is certain that those which do not produce anything of value are far more amiable in their disposition, and may even be domesticated to a certain extent. This is the case with the Common Genette (*Genetta vulgaris*), which is found in most parts of Africa and even in the south of Europe, as far north as France. This animal is often brought up in the house, where it performs the duties of a Cat in destroying Rats and Mice, and the reptiles which often visit the dwellings in warm climates. The fur of this species is soft and elegant, and was formerly in high esteem for making muffs. The species of the genus *Herpestes* are also frequently kept for the purpose of destroying vermin. One of these is the celebrated Ichneumon (*H. Ichneumon*) of Egypt, which does such excellent service to the inhabitants of that country by eating the eggs of the Crocodile, and thus keeping the multiplication of that formidable reptile within moderate limits. Other species, such as the Mungoos (*Herpestes griseus*), destroy the most venomous snakes in the manner already detailed (p. 111). The *Cynogale Bennettii*, an inhabitant

of Borneo, frequently takes to the water in pursuit of fish; and this and several other species feed partly on fruits.

The *Mustelidæ*, or Weasels, forming the next family, approach the Cats in the bloodthirstiness of their dispositions, although their size confines their devastations to the smaller animals. Their bodies are of a more elongated form, and supported upon shorter legs than those of the Viverridæ; and from these circumstances their movements have usually a peculiar gliding character, which renders the appellation of *Vermiformes*, sometimes applied to them, peculiarly appropriate.

In the short, somewhat rounded head, and in the form of the molar teeth, they resemble the Cats; but in the number and arrangement of the the teeth they do not coincide with the Felidæ. The teeth are—incisors, $\frac{6}{6}$; canines, $\frac{1-1}{1-1}$, slender and curved; præmolars $\frac{2-2}{3-3}$ or $\frac{3-3}{3-3}$, molars $\frac{2-2}{2-2}$, of which the flesh-tooth is broad and sharp, and the hinder one tubercular. The feet are all furnished with five toes, armed with sharp claws. Their hair is exceedingly soft and beautiful, and the skins of several species are amongst the most highly-prized furs. They are endowed with great agility, and readily capture small quadrupeds and birds; in pursuit of the latter many of the species climb trees, creeping about upon the branches with the greatest ease. They are celebrated for their love of blood, and are generally charged with destroying great numbers of animals for the sake of drinking this fluid; it is certain that they often kill indiscriminately all the animals they come near, but it appears that the brain is the part to which they first direct their attention. They usually seize their victims by the back of the head, and the canine teeth not unfrequently penetrate directly into the brain. They often commit sad ravages in poultry-yards and hen-roosts, to which they readily obtain access, as the slender form of their bodies enables them to push through almost any crevice.

We have several British species, of which the Common Weasel (*Mustela vulgaris*), the Polecat (*M. putorius*), and the Stoat or Ermine (*M. erminea*), are the best known. The latter is the animal that furnishes the beautiful white fur which constitutes such an important adjunct to all robes of state. This is the winter coat of the animal; in the summer it is reddish-brown above and white beneath, but the extremity of the tail is always black. The Ferret (*M. furo*) is a well-known albino variety of some species nearly allied to the Polecat, supposed to have been originally a native of Africa. It is kept in this country principally for the destruction of vermin, which it pursues into their holes; and also to drive Rabbits from their burrows. When employed for the latter purpose, it is usually muzzled. It is a dangerous inmate, and has more than once been known to attack children sleeping in the cradle, and to inflict serious injuries upon them in the absence of the nurse or mother.

The preceding species generally pursue their prey on the ground, and rarely ascend trees, which constitute the regular home of the Martens, of which two species, the Common Marten (*Martes foina*) and the Pine Marten (*M. abietum*), are found in this country. The animal which furnishes the valuable fur called sable (*M. zibellina*) is nearly allied to the last-mentioned species; it is found in Siberia, whence immense numbers of these and other skins are brought into Europe. The American sable is the skin of another species (*M. leucopus*). The Mink (*Vison lutreola*), a species the fur of which is much used in this country, forms the type of a genus nearly allied to the Polecat.

With the exception of the Martens (*Martes*), all the animals above referred to exhale a most disagreeable odour when alarmed or irritated; this is produced by the secretion from the anal pouch. They are all, however, outdone in this respect by the American Skunks (*Mephitis*), in which the odour of this secretion is intolerably offensive; and if the animals are pursued, they can squirt out this horrible fluid upon the face and clothes of the offending parties. The best known species is the Common Skunk (*M. putorius*), which is generally distributed in North America. Its odour is of the most abominable nature, and when once attached to the person is got rid of with great difficulty.

To this family also belong the Otters, distinguished by their aquatic habits, indicated by the webbing of their toes. Our British species (*Lutra vulgaris*) is about three feet and a-half in total length, and of a dark brown colour. It swims admirably, the legs being loosely articulated, to adapt them particularly for this employment, and, with the assistance of its longish tail, it performs the most graceful evolutions in the water. Its food consists entirely of fishes, of which it destroys great quantities; for, with the characteristic epicurism of the family, it often kills many fish, of which it eats only a mouthful or two of the best parts. It lives in holes in the banks of rivers, generally under the roots of trees; and the stories related by the older naturalists of the ingenuity of the Otter in digging its habitation are entirely without foundation.

The Common Otter has occasionally been trained to catch fish and bring them to its master; but in this country only as a matter of curiosity. In India, however, according to Bishop Heber, a species (*Lutra nair*) is regularly domesticated by the fishermen of some districts; the animals become nearly as tame as dogs, and are employed in driving the fish into the nets, and sometimes in bringing large fish out in their teeth.

A nearly-allied species, the Canadian Otter (*L. canadensis*), has a curious mode of amusing itself during the winter. Several individuals of this species select a spot on the steep bank of some river, whose current has resisted the effects of the frost, upon the snowy surface of which they slide down in succession into the water, returning again to the top of the bank to repeat the operation, just like boys sliding on the ice. The water from their fur being quickly frozen on the snow, soon converts it into a most excellent slide, on which the Otters keep up the game with a most laudable activity. The skin of both this and the European Otter furnishes an excellent fur, which is much used in some countries; but this is greatly exceeded in beauty and value by the fur of the great Sea Otter (*Enhydra lutris*), which inhabits the coasts and islands of the North Pacific Ocean. These animals are killed in great numbers for the sake of their skins, which constitute an important article of commerce between the Russian merchants and the Chinese. The Common Otter, although a native of our fresh waters, is not unfrequently seen in the sea.

The *plantigrade* section of the Carnivora, in which the whole sole of the foot is applied to the ground in walking, contains three families—the Badgers (*Melidæ*), which, although plantigrade, are evidently nearly allied to the Weasels; the Bears (*Ursidæ*); and the Kinkajous (*Cercoleptidæ*).

The animals forming the family of the *Melidæ* or Badgers have been placed by some zoologists amongst the Weasels, by others with the Bears, and by others partly in the one and partly in the other of those families, so that their intermediate position is tolerably evident. In their dentition they closely resemble the animals of the preceding family, the præmolars being compressed and cutting, but the true molar or

flesh tooth is usually furnished with a large blunt tubercle on the inside. Behind this there is a tubercular molar in each jaw. The præmolars vary in number as follows:— $\frac{2-2}{3-3}$, or $\frac{3-3}{3-3}$, or $\frac{3-3}{4-4}$. The body is more or less elongated, and supported upon short legs; the toes are five on each foot.

This family includes but few species, which, however, occur in very various parts of the globe, and some of them enjoy a very wide distribution. Thus the Wolverine or Glutton (*Gulo luscus*) is an inhabitant of all the northern parts of both hemispheres, and was formerly found even in Germany, where, however, it has long been extinct. This animal evidently approaches most closely to the preceding family, which it resembles in its dentition, whilst its appearance is more like that of the typical Badgers, and it is about the size of our English Badger. It is usually of a rich brown colour, darker on the back; the tail is of moderate length and bushy, and there is a fold of skin in place of the sub-caudal gland. It feeds principally on the small Rodent animals which are so abundant in the high northern latitudes; and, although its pace is but slow, its perseverance and determination appear to supply it well with provisions. According to some writers, it ascends trees and throws itself from the branches upon the necks of the larger animals, such as Deer, which may pass beneath its station. The writings of the older naturalists contain the most ludicrously exaggerated accounts of the voracity of the Glutton. It was said, that when this creature killed a large animal, or accidentally met with its carcase, it would feed upon it until its belly was completely distended, when it would get rid of its load by squeezing itself between two trees, and again return to its repast. It appears, indeed, that this animal is cruel and bloodthirsty in its nature; but, according to Voigt, this has nothing to do with its receiving the name of Glutton, which has originated in a most absurd manner. The Finnish name of the animal is "Fiæl-Frass," which means "a dweller among rocks." This name, by an easily intelligible process, became converted into the German "Vielfrass," which means a glutton; and from this slender foundation it is probable all the stories of the excessive voracity of this animal have originated.

The Common Badger (*Meles Taxus*) is a well-known British species, which is also found in most parts of Europe. It is a heavy, slow animal, which passes the day sleeping in its deep and complicated burrow, generally excavated in a thicket on the side of a hill, and comes forth at night in search of his food, which consists indifferently of animal and vegetable matter. It is said sometimes to dig up Wasps' nests, and to devour the combs containing the larvæ. Buffon, who mentions this habit, attributes it to the fondness of the Badger for honey; but as our Wasps do not collect honey, the opinion of the great French naturalist is, of course, untenable. The jaws of the Badger are exceedingly strong, and he bites very severely. His courage is great, and a Badger baiting was formerly a very favourite amusement with our rustic population; the excitement being greatly increased by the fact that the animal's coat is very loose and of a hard leathery texture, so that when the dogs got hold of him, he was able to turn and bite with great ease. The Badger was put into a tub or barrel, and as the dogs were thus compelled to attack him in front, it may easily be imagined that they suffered severely. Nearly allied species are found in India and in North America.

The Ratels or Honey Badgers (*Mellivora*) also belong to this family. The best known species is the Cape Ratel (*Mellivora capensis*), which closely resembles the

Badger both in size and form, but is, perhaps, heavier in its appearance, and has the nose less produced. Its colours are gray above and black beneath, the separation between the two colours being marked with a white line. It burrows in the ground like the Badger, not only to provide itself with a habitation, but also in search of the nests of the wild Bees, of whose honey it is immoderately fond. It has the same loose hard skin with the European Badger, and in this leathery armour it is said to attack the citadels of those irritable insects with impunity.

The family of the *Ursidæ*, or Bears, differs from all the preceding families in the nature of the molar teeth, which although compressed in form, are furnished with tubercular crowns, indicating that the animals are adapted at all events for a partially vegetable diet. The number of teeth of this description is usually two or three on each side in each jaw; the total number of molars and præmolars is either five or six, but some of the latter frequently fall out with age. The Bears are generally large, heavy animals, and strictly plantigrade in their walk, which is awkward and shuffling in its nature; the anterior limbs are, however, possessed of great mobility, and even the most bulky of these animals manifest great dexterity in climbing. Their feet are armed with long curved claws, with which they dig in search of roots and other articles of food. Their bodies are usually covered with long shaggy hair, and the tail in the typical Bears is remarkably short, whilst in some of the other animals referred to this family it is of considerable length. The ears are small, and the nose is more or less produced and moveable, in some species forming a sort of proboscis.

The Bears are generally inhabitants of the wooded districts of mountainous countries. They occur in all parts of both Hemispheres with the exception of Australia. The most generally distributed species is probably the common Brown Bear (*Ursus Arctos*) which was anciently an inhabitant of our own country, and is still found in all the mountainous regions of Europe, from the extreme north to the Apennines and Pyrenees, and also in the north of Asia. This well known and powerful animal feeds principally upon vegetable substances, such as roots and berries; he also devours worms and insects, especially ants, and now and then makes a meal upon some of the smaller Mammalia, when they come in his way. His partiality for honey has been long known, and in some places he is said to manifest a great fondness for fish. He rarely attacks men unless irritated or wounded, but then his great strength and courage render him a most formidable adversary. The Bear is hunted principally for the sake of his skin and fat; the latter being considered to form a peculiarly excellent application to the hair. His flesh is also eaten, and the broad paws especially are regarded as a dainty morsel; the hams when cured are also in great repute. Notwithstanding his ferocity, the Bear is frequently tamed, and taught to dance, and in menageries his rude appearance and grotesque attitudes, especially when standing on his hind legs, always make him a great favourite with the younger members of the community. The American Black Bear (*U. Americanus*) is another species very closely allied to the European Brown Bear; it inhabits all parts of the North American continent, and closely resembles the Brown Bear in its habits. Another remarkable American species is the Grisly Bear (*U. ferox*), which is about twice the size of the common species. This tremendous animal is principally found in the south-western portion of the North American continent, in the neighbourhood of the Rocky Mountains, and in California; it is apparently more ferocious than either of the preceding species, feeding to a greater extent on animal food, and even according

to some travellers, destroying the powerful north American Bison. These species all appear to pass the winter in a torpid state.

The Mountains of Syria and India possess several species of Bears, amongst which we may notice the singular Jungle Bear (*Prochilus labiatus*), which is covered with long hair, and is rendered remarkable by the protrusibility of the lips. This Bear is a favourite with the jugglers and mountebanks of India, who exhibit in the villages; it has not unfrequently been brought to Europe, and was described by the older naturalists as a sloth, from the specimen first brought having lost its front teeth. In some of the old Natural History Books it figures under the curious and not very intelligible title of "the Anonymous animal."

One or two species of Bears are found in the larger Eastern Islands (such as Sumatra and Borneo) which are at once distinguished from the northern members of the family by their smooth glossy hair. They are of a milder disposition than the common Bears, and feed almost entirely on vegetable substances. Like their European relative they are excessively fond of honey, which is an abundant article in the forests where they reside. In confinement these Bears appear to be playful and affectionate, but their great strength renders them rather formidable pets. They form the genus *Helarctos*, or Sun Bear; the species first described was the Malayan Sun Bear (*H. malayanus*); the Bornean Sun Bear (*H. euryspilus*) is by many naturalists regarded as a mere variety of this.

One of the largest and probably the most ferocious of the Bears is the White Bear (*Thalassarctos maritimus*) which is exclusively confined to the highest northern latitudes, where it resides upon the ice, and frequently takes to the water. It is carnivorous; indeed in the regions which it inhabits it would be impossible for it to find any suitable vegetable nourishment. Its principal food consists of the floating carcases of animals, such as dead Whales, Seals, and fish, but it is said also to capture living Seals, by watching for them when they come up at their breathing holes. The White Bear is remarkable for having the soles of his feet clad with hair, which is supposed to give it a firmer footing upon the ice. The bones of an enormous species of Bear (*U. spelæus*) have been found in the same cave with those of the Hyæna, already noticed.

Besides the Bears, several species of small American animals are referred to this family, these are the Racoons (*Procyon*) and the Coatis (*Nasua*). The animals of both these genera are furnished with tails of considerable length; their legs are shorter and their muzzles more pointed than those of the true Bears, and they are also distinguished from the latter by several more important characters.

The Racoons are found in the tropical parts of America, and also in the warmer parts of the northern division of that continent. The common species (*Procyon lotor*) is abundant in the woods of the latter locality; it is about two feet long in the body, of a grayish brown colour, with a tail about ten inches in length, annulated with black. Its nose is slender and pointed, reminding one of that of a Fox. It is a nocturnal animal and very predaceous in its habits, making great havoc amongst the birds and smaller mammalia; it is remarkable for its custom of dipping each morsel into water before eating it, whence its specific name of *lotor*, or the washer. In captivity it is easily tamed, and becomes very playful, but its disposition appears to be uncertain.

The Coati (*Nasua narica*) is smaller than the Racoon, and is distinguished from that animal by the greater length of its tail and the production of its nose into a

moveable snout or short proboscis. It is found in the tropical parts of America and resembles the Racoons in its mode of life.

The Wah, (*Ailurus fulgens*) of India, is also placed by some authors in this family, which it appears to unite with the Civets; by others it is transferred to the latter group.

The last family of the Carnivorous Mammalia is that of the *Cercoleptidæ*, or Kinkajous, a group of small animals inhabiting the tropical parts of America, which exhibit some resemblance to the Bears in their dentition, but differ from them in their general characters. Their canine teeth are short and blunt; behind these are two small pointed præmolars, which are followed by three tuberculated molars. The feet are as truly plantigrade as in the preceeding family, but the toes, which are always five in number, are more distinctly separated, and capable of a greater amount of independent motion. They are small, short legged animals, covered with a woolly fur, and furnished with a long prehensile tail.

In their form and general habits, the Kinkajous present no small resemblance to the Lemurs, and like these they are of a gentle and playful disposition in captivity. They are nocturnal in their habits, and appear to be almost omnivorous, feeding indifferently upon small birds and mammalia, birds' eggs, insects and fruits, in pursuit of which they climb trees with great activity. Like the Squirrels they use the fore paws in place of hands to convey their nourishment to their mouths. They are said to be exceedingly fond of honey, and to plunder the nests of the wild Bees with great boldness. The *Cercoleptes caudivolvulus* is the best known species; it is often tamed as a pet, and is commonly seen in our menageries.

Besides the Bear and Hyæna already referred to, the remains of numerous species of Carnivorous Mammalia have been found in the tertiary strata, but more especially in the most recent of those formations,—and it is remarkable that tropical forms of large size, appear to have inhabited this island at a period which must have been (geologically) but little antecedent to the creation of man.

## Order X. Insectivora.

**General Characters.**—The Insectivorous Mammalia, are readily distinguished from the Carnivora, with which however they are nearly allied, by the structure of their teeth. These rarely exhibit that distinct division into three sets, which prevails in the preceding order, and it is sometimes difficult to determine exactly what name should be given to the particular teeth. There are usually eight single-rooted teeth in the front of each jaw, of which the hindmost on each side, must be regarded as the canine, although it is often smaller than the others, especially the two middle ones. Behind this comes a tooth with two roots, which is frequently more or less compressed, and presents a certain amount of resemblance to the larger præmolars of the Carnivora, and this is followed on each side by two large broad molars, the crown of each of which usually forms four sharp points, with deep hollows between them, so that the points of the teeth in one jaw interlock with those of the other. These large molars are often succeeded quite at the back of the mouth by a smaller tooth of the same kind, which, however, only presents two points. By this structure of the molars, these animals are enabled readily to crush the hard skins of the insects which constitute their principal food.

The skull in the Insectivora is slighter and more elongated than in the Carnivora;

the bones of the face and jaws being usually produced so as to form a muzzle of greater or less length; the jaws are generally inferior in strength to those of the Carnivorous Mammals. The form of the body, its clothing, and the development of the tail, vary as much as in the preceding order, but the legs are always short, so that the belly of the animal is but little raised above the ground; the feet are plantigrade, and usually furnished with five toes, of which the innermost is never opposable. The animals usually run upon the ground, sometimes dig beneath its surface, and sometimes ascend trees. An important distinction between them and the Carnivora, is furnished by their possession of complete clavicles, which are always wanting or rudimentary in the latter. The mammæ are generally numerous, and always situated on the belly.

In the development of the brain and organs of the senses, they closely resemble the Rodentia, and this similarity is also frequently recognizable in their external form; so close is it in fact, that many members of the present order are popularly confounded with the Rodentia, and the same mistake has often been made by the older naturalists. In the same way the Insectivora exhibit a close resemblance to many of the Marsupials, whilst, on the other hand, their relationship to both the following orders cannot be doubted. Their food consists not only of insects and their larvae, as might be supposed from the name given to the order, but also of worms and mollusca, and some of the larger species even devour the smaller vertebrate animals. They are generally slow in their movements and nocturnal in their habits, and many of them pass the winter in a state of torpidity.

**Divisions.**—The animals composing this order may be divided into two families. The first of these is that of the *Talpidæ*, or Moles, in which the whole structure evidently points to the strictly subterranean habits of the animals. The body in the Moles is short and thick, and supported upon short and strong legs; the head is produced into a long muzzle; the eyes are either so small as to be detected with difficulty, or completely concealed beneath the skin; and the external ears are entirely deficient. The internal ear is very perfect, and the olfactory organs are highly developed, so that those senses which must be most valuable to animals confined to a subterranean existence are possessed by the Moles in the greatest perfection, whilst the sense of sight, which is comparatively useless to a creature which passes the greater part of its time in utter darkness, is almost entirely suppressed. The tail is usually short, or quite rudimentary.



Fig. 365.—The Mole (*Talpa europæa*).

For the excavation of the galleries which these animals make in pursuit of insects and worms, and in which they almost constantly reside, their anterior limbs, although short, are exceedingly powerful, and so arranged as to form most efficient instruments for digging. Thus in the common Mole (*Talpa europæa*, Fig. 365), the only British species of the family, the bones of the arm are very short and strong, and the limb is terminated by a broad, flat, shovel-like hand, armed with long and strong claws, furnished with a curved prolongation of one of the carpal bones (called the *falciform bone*), which gives additional strength to the hand, and so placed that its palm is natu-

rally turned directly backwards. By the agency of these digging hands, the Mole burrows with great rapidity, and the galleries which it forms are of a very complicated nature. In the genus *Chrysochloris*, of which several species inhabit South Africa, the anterior feet have only three toes; but in the majority the structure is much the same as in our common Mole.

The latter, which may serve as a general illustration of the family, is found in most parts of Europe, and is well known for its curious cylindrical form, and the blackness of its velvet-like coat. Its eyelids are open, and it has been proved by experiment to have the power of sight, although it is a popular belief that the Mole is quite blind; this, indeed, is the case with another species, inhabiting the south of Europe (*T. cæca*), which is supposed to be the Mole referred to by those ancient naturalists from whose statements the charge of blindness has been applied to our species. Although the greater part of this animal's labour in digging is undoubtedly expended in the pursuit of food, a portion of his excavations are of a more permanent nature, serving for his regular residence, and as a high road leading from this to different parts of the district which he has appropriated. His residence consists of a large hillock of earth, firmly beaten together, and placed in some secure situation; within this are two circular galleries, one above the other, and communicating by five short passages; the chamber inhabited by the animal is excavated in the centre of the lower gallery, and communicates with the upper one by three short passages. From the bottom of the chamber runs a short passage, which descends for a certain distance and then rises again towards the surface, until it falls into the high road leading from the residence to the creature's hunting ground; this also communicates with the lower gallery, and forms one of about nine tunnels, which issue from all parts of the latter, and which are said by the French naturalists to open again into the high road at various distances. The high road is much larger than any of the ordinary tunnels made by the Mole in searching for his prey, which open out from it in various directions, and its object is evidently to give the animal a free and rapid communication with his fortress,—in fact, an experiment performed in France proved that the speed with which a Mole, when alarmed, traversed the course of his main tunnel was nearly equal to that of a horse at full trot. The depth at which the road is made varies according to circumstances; in ordinary situations, it is rarely more than four or five inches, but in passing under a road, or any other place where it is exposed to much pressure, the animal will carry its burrow to the depth of a foot or more. Whilst burrowing in search of food, the Mole constantly comes to the surface, where it makes an opening, and through this the earth loosened in its excavations is got rid of; it forms the little heaps well known as Mole-hills. It is a most voracious animal, and a very short fast is fatal to it; in fact, when two individuals in captivity are not sufficientlys upplied with food, the weaker is always killed and devoured by the stronger one. In winter the Mole continues active, but in severe weather usually seeks its food at a greater depth in the ground; in the summer, on the contrary, it frequently quits its abode at night, and hunts for insects and worms on the surface. It swims well, and often takes to the water, sometimes for self-preservation when its retreats are invaded by floods, sometimes in changing its abode, when its course is stopped by a rivulet, and occasionally, according to some writers for the mere pleasure of taking a bath. It is a fierce little creature, and bites severely when incautiously seized. The males also have most sanguinary and fatal combats in the season of their amours.

Of the exotic species, those of the genus *Chrysochloris*, already referred to on account of the structure of their anterior limbs, are further distinguished by the peculiar metallic lustre of their coats, which has given rise to the name of Golden Mole (*C. aurea*), applied to the best known species. The *Scalops aquaticus*, a native of Canada and the United States, is commonly known as the Shrew Mole, from the resemblance of its dentition to that of the Shrews, which form the types of the following family. In the genus *Condylura*, the species of which are also inhabitants of North America, the nose is surrounded by a number of small movable cartilaginous filaments, which radiate somewhat in the form of a star, and are doubtless employed as organs of touch. In their general habits all these animals resemble our common Mole.

In the family of the *Soricidæ*, or Shrews, which includes the greater part of the order, the feet are all formed for progression; that is to say, the anterior members are never converted into organs appropriated for digging. The eyes are always perfect and readily distinguishable, and the external ears, though small, are always present. In other respects, the different animals composing this group exhibit a remarkable variety of character; the dentition presents considerable differences even in closely allied species; the length of the legs and tail, and the clothing of the body, are also very variable. They all, however, agree in living either on the surface of the ground or upon trees, and never in a complicated system of burrows, such as that of the Moles; their jaws are always more or less elongated, and the nose is usually prolonged into a moveable snout. The Soricidæ are found in all parts of the world; they are of small size, and their nourishment consists principally of insects, although some species also feed on vegetable matters.

In the typical Shrews, forming the genus *Sorex* and its allies, the form of the body presents a close resemblance to that of the Mice and Rats, whence the name of Shrew Mice is frequently applied to our English species. Their legs are of nearly equal length, and terminate in five toes, which are armed with small claws and usually free, though not unfrequently united by a swimming membrane. The nose is more or less produced, and the tail is elongated, usually tapering, covered with scales, like that of the Mice, and with a greater or less number of bristles. The skin is clothed with a short fur. Some of these are amongst the most diminutive of the Mammalia, and the largest of them are about the size of a Rat. They are generally furnished with peculiar glands, secreting a fluid of a disagreeable odour, which prevents Cats and Dogs from eating them, although they will not unfrequently kill them, probably mistaking them for Mice. They live for the most part upon insects, worms, and small Mollusca; but the larger species also prey upon the smaller Vertebrata.



Fig. 366.—The Common Shrew (*Sorex araneus*).

Our British species all belong to the typical genus *Sorex*, and are amongst the smallest of British animals. The Common Shrew (*S. araneus*, Fig. 366) is well known and generally distributed; it inhabits dry places, where it grubs about amongst the herbage with its pointed snout in search of the insects and worms on which it feeds. It is a pugnacious little creature, and, like the Moles, if two of them are put together they always fight until the weaker is killed, and devoured by his companion. It is remarkable that in the autumn great numbers of these animals are to be seen lying

dead in their haunts, without any apparent injury; the cause of this mortality has not been ascertained. The Water Shrew (*S. fodiens*), another British species, is usually found in the neighbourhood of water, in which it swims and dives with great facility in search of insects. It burrows in the banks of rivers and brooks, and is rarely seen to wander from such situations. A third British species, the Oared Shrew (*S. remifer*), resembles the Water Shrew in its habits.

The genus *Sorex* may be regarded as the type of a subfamily, to which the name of *Soricinæ* may be given. Species of this group are found in various parts of both hemispheres, but principally in Europe and Africa. Amongst these we shall only notice the Desmans (*Mygale*), sometimes called Musk Rats, of which two species are found in Europe—one in the Pyrenees (*M. pyrenaica*), and the other in Russia (*M. moschata*). These animals are the largest in the group; they are remarkable for having the nose produced into a short proboscis, and their feet palmated and naked or scaly. They always inhabit the neighbourhood of water, in which they swim with great facility, and feed not only on insects and Mollusca, but also on small fish and frogs. They are also remarkable for the strong odour of musk which they exhale.

The *Macroscelidinæ* are small animals, nearly allied to the true Shrews, but differing from them by having the hind legs much elongated, so that they are enabled to spring in the same way as the Jerboas amongst the Rodentia. Their noses are long, and often produced into a trunk; their eyes and ears are larger than in the true Shrews, and their tails are long, and usually covered with hair. These small animals are peculiar to Africa, and are most numerous in its southern parts. One species, however, is found in Algeria, where it is known to the French colonists as the *Rat à trompe* (*Macroscelides Rozeti*). They live principally in dry rocky places, and feed on insects and other small animals, although it appears that some of them also eat vegetable substances.

In the *Erinaceinæ*, or Hedgehogs, which are the largest members of the family, the body is short, thick, and stout; the nose is less pointed than in the other groups, the tail is short or entirely wanting, and the upper surface is more or less covered with short spines, which, when the animals roll themselves up into a ball, as they always do when alarmed, present an almost insuperable obstacle to any predaceous animal that may wish to make a meal on the Hedgehog's body. They are exclusively confined to the Eastern Hemisphere, where they are principally found in the warmer regions. They are omnivorous and nocturnal animals, sleeping during the day in holes under the roots of trees or stones, and in similar situations, and coming forth at night in search of insects, fruits, and roots. Those which inhabit cold climates pass the winter in a state of torpidity.

Our only British species is the Common Hedgehog (*Erinaceus Europæus*), an animal which is too well known to need any description. It is found in woods and hedgerows in most parts of the country, and is not unfrequently kept in kitchens for the purpose of destroying cockroaches. It feeds freely upon almost all kinds of animal and vegetable matter, and kills and devours animals which none of the other Insectivora would venture to attack, such as Snakes, which it eats, according to Mr. Broderip, "as one would eat a radish," commencing at the tail and eating upwards. In illustration of the strength of the prickles in its skin, Professor Bell states that he has repeatedly seen a Hedgehog belonging to himself precipitate itself down an area twelve or fourteen feet deep, and, by rolling itself up into a ball, arrive at the bottom without the least injury.

Several other species inhabiting Asia and Africa belong to this group, which also includes the Tanecs (*Centetes*) of the Island of Madagascar, in which the tail is entirely wanting, and the spines, which are far weaker than in our common Hedgehog are mixed with silky hairs.

The *Tupainæ*, or Banxrings are organised for an arboreal existence; they resemble the Squirrels in their movements and also present a certain similarity to the Lemurs. Their legs are of nearly equal length, but longer than in the majority of the other Soricidæ, so that the body is always raised from the surface of the ground; their skulls present a striking peculiarity, their orbits being completely encircled by a bony ring, whilst in the other members of the order these cavities open into the temporal fossæ, and even the zygomatic arch is incomplete in many cases. The Banxrings are rather elegant little animals, furnished with long tails, which are generally well covered with hair, but in the *Ptilocercus Lowii*, a native of Sumatra, the tail is naked and scaly, except towards the extremity, where it bears two series of longish hairs, arranged something like the barbs of a feather. Most of the species of this group are found in the larger islands of the Eastern Archipelago (Java, Sumatra, and Borneo), but one or two species have been brought from Pegu and India. They live in the woods, where they climb the trees with great agility, and feed upon insects and fruits. In eating they hold their food between their fore paws, in the manner of a Squirrel, and, unlike the majority of the animals of this order, their period of activity is the day.

## ORDER XI.—CHIROPTERA.

**General Characters.**—This order includes those species of the class Mammalia in which the general characters of the group are most singularly modified, so as to adapt them for the exercise of the power of flight, of which they alone of all the Mammalia are possessed. In three other groups of this class we meet with animals to which the appellation *flying* has been given, but these only possess the power of gliding through the air from one point to another, by the agency of an expanded skin, which serves to buoy them; their aërial motion consequently differs only in extent from the spring of an ordinary Mammal; in the present order, on the contrary, the anterior members are as completely organized for true flight as those of a bird, but the purpose is fulfilled in a very different manner.

In these animals, which are well known as Bats, as in the Birds, the bones supporting the anterior members are large, the humerus is rather short, and the bones of the forearm long, but the latter are quite separate and moveable as in the human arm. The bones of the fingers, however, instead of being amalgamated, so as to form a single series, are all quite distinct, and when extended radiate widely from the wrist, the bones of which are of small size. The thumb is short, but the other four fingers are excessively elongated, especially in the metacarpal region; the first finger is the shortest, and the others are of nearly equal length. The four long fingers and the bones of the arm are united by a delicate leathery membrane, which is also united to the sides of the body as far as the extremities of the hind legs and sometimes fills up the space between these, and it is by the agency of the broad wings, formed by the extension of the arms and fingers (Fig. 367), that the Bats are enabled to flutter through the air; their flight however is less powerful than that of the majority of birds. The

thumbs of the anterior feet are small, free, and furnished with sharp curved claws, by which the animals can suspend themselves to the walls of the cavities they




Fig. 367.—Skeleton of a Bat.—*cl*, clavicle; *h*, humerus; *cu*, ulna; *r*, radius; *ca*, carpus; *po*, thumb; *mc*, metacarpus: *ph*, phalanges; *o*, scapula; *f*, femur; *ti*, tibia.

inhabit, and the thumbs, with the hind feet, which are also free from the membrane, constitute the only means by which the Bats can progress on the ground, where, as might be expected from their organization, they are exceedingly awkward in their movements. The hind feet are usually furnished with five distinct toes, all armed with sharp claws; they are small, but capable of clinging with great firmness.



Fig. 368.—Long-eared Bat walking. (*Plecotus auritus*).

The skull in these animals is usually short, the jaws being but moderately produced; the dentition varies in the different families, according to the food on which the creatures subsist. The sternum is furnished with a more or less distinct crest, serving, like the same part in birds, for the attachment of the powerful muscles of the wings. The tail is very variable in its development, and is frequently included in a portion of the membrane, (called the *interfemoral* membrane), which extends from one hind leg to the other, and which evidently performs an important part in steering the animals in their aërial course. The body is covered with a soft down, but the membrane of the wings only exhibits a few scattered hairs. The mammæ are placed on the breast, and the young, when sucking, are carried about by the mother clinging to that part of her body; from the position of the teats, the Bats were included by Linnæus with the Monkeys and the human species in his first order, the Primates.

The senses of the Bats are exceedingly acute, especially those of hearing and smell; the ears are frequently of enormous size, and both these and the nose furnished with lobes of skin, which probably give increased intensity to the senses of hearing

and smell, and may also be accessories to that exquisite sense of touch which is certainly exercised by the delicate membranes of the wings. By this sense the Bats, which are all nocturnal or twilight animals, are enabled to avoid objects which stand in their way, even when they cannot see them, as was proved by the experiments of Spallanzani, who blinded several of these animals, and found that in this mutilated condition they still avoided coming in contact with threads suspended in the room where they were flying.

All the Chiroptera, as already stated, are nocturnal in their habits. During the day they sleep suspended by the claws of their hind feet from the sides of caves, hollow trees, or holes in walls; and the European species are also very partial to the walls of old chimnies. Those species which pass the winter in a state of torpidity select the same situations for their long slumber. They are found in all parts of the world, even in New Holland, but are most numerous in tropical climates. Some species feed upon insects which they capture on the wing, others upon the blood of vertebrated animals, and others again upon fruits.

**Divisions.**—The Chiroptera may be divided into four families, of which the first two include the preeminent insectivorous species. The first of these is that of the *Vespertilionidæ*, or true Bats, in which the teeth resemble those of the true Insectivorous Mammalia, but vary greatly in number. The incisors are two or four in the upper, and two, four, or six in the lower jaw; and the molars either four or five in the upper, and five or six in the lower jaw. The canines are rarely of large size; the anterior or false molars are compressed and cutting, and the true molars are furnished with sharply tubercular crowns, adapted, like those of the Insectivora, for crushing the hard skins of beetles and other insects. All the fingers are quite destitute of nails or claws, and the middle finger has only three joints; the tail is usually well developed, and fixed in the interfemoral membrane, but is sometimes free (*Taphozous*); it is also occasionally longer or shorter than the membrane, but generally reaches its posterior margin. The ears vary greatly in size, being sometimes shorter than the head and sometimes very long, and furnished with an inner fold (Fig. 368); but the nose is always destitute of leaflike appendages.

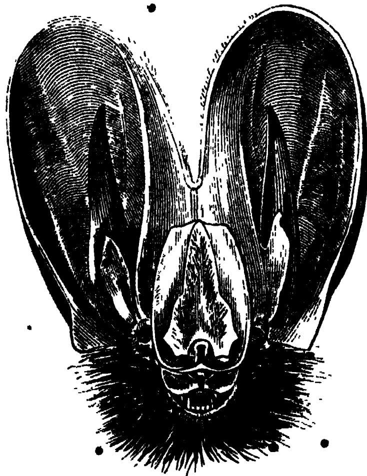
The animals of this family feed entirely upon insects which they capture on the wing, and during the dusk of the evening in summer they may constantly be seen flying about in pursuit of their insect prey. Although of small size, they are exceedingly voracious, and must destroy immense numbers of insects. They are found abundantly in all parts of the world, and no fewer than fifteen species are described as natives of Britain: but of these the great majority are very rare or local. The two commonest species are the Pipistrelle (*Vespertilio pipistrellus*) and the Long-eared Bat (*Plecotus auritus*). The former is our common Bat, which is known in some parts of the country as the Flittermouse, in allusion to its mouselike body and its power of flight. It is commonly found about houses, and usually reposes in the crevices of old walls and similar situations. It is a small species, and its food consists principally of gnats and other little insects of the same description, in pursuit of which it flies pretty rapidly. The Pipistrelle is also partial to meat, and is known frequently to make its way into pantries, where it has been surprised clinging to a joint of meat in the act of making a hearty meal. Its period of torpidity appears to be shorter than that of any of our other species of this family, and even during the winter it may occasionally be seen on fine days in pursuit of its favourite prey.

The Long-eared Bat (Fig. 368), like the preceding, is also found commonly in the

neighbourhood of houses, under the roofs of which and in the towers of churches it commonly reposes during the day. It is one of the most elegant species, and is very easily tamed, when it will readily take flies from the hand, and even in some cases from the lips of its owners. The ears are very long, and beautifully transparent; they can be bent and folded into a great variety of forms, and when the animal is sleeping they are concealed under the wings, whilst the inner lobe of the ear still projects, giving the creature the appearance of having short, slender ears.

The largest British species is the Noctule, or Great Bat (*V. noctula*), which measures nearly three inches in length exclusive of the tail, and as much as fifteen inches in expanse of wing. In their habits the exotic species closely resemble those which inhabit Britain, and few of them greatly exceed our British species in size.

The second family is that of the *Rhinolophidæ*, or Horse-shoe Bats, which resemble the true Bats in their general structure and habits, but differ from them remarkably in the possession of complicated leaflike membranous appendages on the nose, which give them a very singular and often forbidding appearance (Fig. 369). They resemble the common Bats in their general habits, but appear to be even more nocturnal; and their places of sojourn during the day are usually the darkest caverns that they can find.


Fig. 369.—Head of Megaderma frons.

Of these Bats, which are abundantly distributed in the warmer parts of the earth, although peculiar to the Eastern Hemisphere, we have only two native species, the Greater and the Lesser Horse-shoe Bats (*Rhinolophus ferrum-equinum* and *hipposideros*). The name of Horse-shoe Bats, applied to these animals, refers to the form of the anterior portion of the nasal appendage which surrounds the nostrils, and which is somewhat of the shape of a horse-shoe; behind this is a second portion, lanceolate and standing up in front of the forehead, the centre of which is elevated into a remarkable cellular process. The largest of these species is nearly two inches and a half long in the body; it feeds upon rather large insects, such as cockchafers, of which, however, it is said only to eat the body. The Lesser Horse-shoe Bat is one of the smallest British species of the order.

In our British species the ears are of moderate size, but in many of the exotic Horse-shoe Bats these organs are developed to an extraordinary extent, and furnished, as in the Common Long-eared Bat, with very large membranous auricles. This is especially the case in the genus *Megaderma*, in which the ears are so large as to unite in the middle (Fig. 369). The nasal appendages also attain a great development in this genus, species of which are found in tropical Africa, India, and the Eastern Islands; the species figured (*M. frons*) is a native of Western Africa. One of the

Indian species (*M. lyra*) has been observed to suck the blood of other Bats, and it is also said to be partial to Frogs.

In the Megaderms there is an ample interfemoral membrane, but no tail; in the genus *Rhinopoma*, on the contrary, there is a long slender tail, with scarcely any membrane, a structure which gives those animals a most singular appearance. In the genus *Nycteris*, both the tail and the interfemoral membrane are greatly developed, the ears are large but separate, and the nasal appendages are concealed. These Bats have the skin of the body very loose, forming a sac, which communicates with the mouth by a small opening in each cheek; through these apertures the animal is able to puff out the body into the form of a ball, but the object of this arrangement is not known. The species of this genus are almost confined to Africa.

In the family of the *Phyllostomidæ*, or Vampyres, the canine teeth are of large size, and the middle finger consists of four joints, including the metacarpus. Like the Rhinolophidæ, which they replace in America, they are furnished with a membranous nasal appendage, and the ears are usually ample, and furnished with a distinct membranous auricle. In almost all the species of this family there are four incisor teeth in both jaws.



Fig. 370.—Head of the Vampyre Bat (*Phyllostoma spectrum*).

The Phyllostomidæ are peculiar to the tropical portions of America, where they are met with very abundantly. They are generally of a larger size than the animals of the preceding families, the Vampyre (*Phyllostoma spectrum*, Fig. 370) being sometimes nearly two feet and a half in extent of wing, and their propensities exhibit a corresponding degree of ferocity. Their favourite food appears to be the blood of the larger Mammalia and birds, which they attack during sleep, and biting a small hole in the skin, suck the blood through it. Cattle and Horses are very subject to their attacks, and appear frequently to lose a good deal of blood from the wound after the Bats have taken their fill; but it seems probable that, unless an animal has been bitten severely in several places, the bite is rarely attended with ill consequences. Fowls, however, are said often to die from the effects of the bite. The older naturalists, deceived by the accounts given to travellers by the Indians of America, have published the most exaggerated statements of the dreadful powers of these creatures, which were said to attack men during the night by opening an artery and sucking the blood, lulling their victims the while by fanning them with their long wings, until the loss of blood terminated in utter exhaustion. According to Azara, however, the inhabitants of Paraguay have no dread of these animals, although they frequently enter the houses, and suck the blood of those who may incautiously expose any part of their bodies; but he adds that, beyond a painful sensation which lasts for some days, he never found any ill effects from their attacks. He states that they do not open any of the larger vessels, but merely make a

small incision in the skin. Tschudi, however, mentions the case of an Indian who was bitten in the face by a species of this family, whilst sleeping in the woods in a state of intoxication; the wound, although apparently very slight, was followed by so much inflammation and swelling that the man's features became quite unrecognizable.

In the majority of these species the canines are long and sharp, and in the genus *Desmodus*, which possesses only two incisor teeth in the upper jaw, these are also of great size and very acute, forming a pair of formidable lancets. Nothing is known of the habits of the species of this genus, but from the structure of their teeth they would seem to be well adapted for the same diet as the true Vampyres. Another remarkable form of this family is the genus *Glossophaga*, in which the tongue is very long, slender, and extensible; they are said to use this as a suctorial organ, but nothing certain is known of their habits. The species of the genus *Stenoderma* are distinguished by their frugivorous habits; their tails are quite rudimentary, and the interfemoral membrane very small; this is also the case in *Desmodus* and some of the *Glossophagæ;* but the latter genus contains species with both the tail and the interfemoral membrane well developed.

The last family of the order, and the one which evidently approaches most closely to the Quadrumana, is that of the *Pteropopidæ*, or Roussettes, sometimes called Fox Bats, in allusion to the dog-like form of the head, of which the jaws are more prolonged than in the other Bats. In these Bats the incisors are of small size, and four in each jaw, but they sometimes fall out as the animals increase in age; the canines are also small, and the molars have blunt tubercular crowns, indicating a fruit diet, but the tubercles are often worn away, and the teeth then exhibit a flat surface. The ears are always of moderate size; the eyes are larger than in the other Bats, and the nose is always destitute of membranous appendages. The tail is short, and the interfemoral membrane very small or entirely deficient. The first finger is short, and furnished with a distinct nail or claw.



Fig. 371.—Head of the Kalong Bat (*Pteropus edulis*).

The Pteropidæ are entirely confined to the warmer parts of the Eastern Hemisphere. They are most abundant in the islands of the Eastern Archipelago, whence the greater part of the species are derived; but they occur also on the main land of Asia, in the tropical islands of the Pacific, in Africa, and even in Australia. They are the largest of the Bats, the Kalong of Java (*Pteropus edulis*, Fig. 371) measuring no less than five feet in extent of wing, and nearly two in length. They are frugivorous in their habits, and thus do great damage in gardens and plantations; but in confinement they have been known to eat the flesh of birds, so that it is possible they may vary their diet in a similar manner in a state of nature. They have a disagreeable odour, described by some observers as musky, by others as "mildewy." Their flesh is, however, eaten by the inhabitants of the places where they occur; and it is probable that the Bat which

figures amongst the articles of food forbidden to the Jews may have belonged to this group, as at least one species (*Eleutherura ægyptiaca*) is found abundantly in Egypt and the neighbouring countries, and is even represented with considerable exactitude upon some of the Egyptian monuments. Like the other Bats, they are nocturnal animals, and pass the day suspended by the hind feet from the branches of trees; but some species are known also to fly at noonday.

## ORDER XII.—QUADRUMANA.

**General Characters.**—It is amongst the highest animals of this order that we find the nearest approach in organization to the structure which characterizes man as an animal, although it must be confessed that the resemblance is still rather distant. On the other hand those members of the order which stand at the bottom of the scale present remarkable similarities to animals belonging to the preceding and some other orders, and between these two extremes we find a great number of steps. This great diversity of structure renders the determination of the exact limits of the order somewhat difficult, and although the majority of the Quadrumana are easily recognizable, the order also contains some animals whose title to such a position is rather doubtful.

The essential character of the group consists in the structure of the extremities. In the typical forms, all the feet are furnished with opposable thumbs, so that they are in fact converted into hands, by means of which the creatures are admirably fitted for an arboreal existence. In many species, however, the anterior members possess only four fingers, and the opposable thumbs are confined to the hind feet, and the almost universal prevalence of this structure throughout the order may be considered as their most characteristic peculiarity; a similar confirmation occurs nowhere else amongst the Mammalia, except in some of the Opossums. In their movements these animals are as truly Quadrupeds as most of the clawed Mammalia, for in a state of nature they appear never to walk on the hind legs, which in fact are too weak to be employed as in the human subject as the sole organs of motion, and moreover the structure of the feet is such that when on the ground the animals are compelled to walk upon the side of the foot, instead of applying the sole to the ground as in man. Thus we see that however remarkably the general appearance of some of these creatures may simulate that of man, there is in reality a wide difference between the highest Monkey and the most degraded forms of the human species.

In the structure of the brain and skull these animals also exhibit a gradual approach to the human type, but the differences, especially in the latter, are still very striking. In the most man-like Apes the resemblance of the skull to that of man is greatest in the young animals, and as these have been most frequently under the observation of naturalists, they have given rise to very false notions as to the extent of this similarity, for as the animals increase in age, the jaws gradually lengthen until in the adult Orangs and Chimpanzees, they form a prominent muzzle, almost as long as that of a dog. The dentition also is very different, the canine teeth especially being exceedingly large and strong, and interlocking like those of a carnivorous animal; thus it becomes necessary that gaps should be left between the canines and the incisors or false molars for the reception of the canines of the opposite jaw, whilst in man the teeth run in an uninterrupted series in both jaws. The form of the teeth is, however, very similar to that which prevails in the human subject, the molars being broad and obtusely tubercular, as indeed is generally the case in animals which feed on fruits or on a mixed diet.

The orbits are always completely closed, and the eyes of moderate or large size. The ears are usually small, but vary greatly in form. The skin is covered with hair on all parts, except the palms of the hands and the face, and buttocks of some species. The tail is sometimes rudimentary or wanting, but usually of considerable length, and its extremity is often capable of being employed as a prehensile organ, which is of great service to the animals in their arboreal residence. The nails are generally flat like those of man, but some species are furnished with curved claws, whilst others possess such claws on some of the fingers, and flat nails on the rest. The mammæ are usually two in number, and placed on the breast, as in the preceding order.

The Quadrumana vary greatly in size, some of the Apes exceeding even man in stature, whilst others are not larger than a Squirrel. They are almost exclusively confined to the tropical regions of the earth, where they live in troops in the forests, and feed for the most part upon fruits, although a good many are not averse to animal food when it comes in their way, and some even appear to subsist habitually upon it.

**Divisions.**—We may divide the Quadrumana into four sections. The first of these includes only the family of the *Galeopithecidæ*, or Flying Lemurs,—a small group of animals which evidently connect the Quadrumana with the Chiroptera, and which have, indeed, been placed in the latter order by many zoologists. They certainly differ in many important particulars from the other members of this order, and especially in the total want of opposable thumbs on all the feet, which are composed of five fingers, arranged in a single series, and united together by a small membrane. These fingers are, however, adapted for climbing, and are not, as in the Bats, prolonged to furnish support to broad membranous wings, although the animals are furnished with a very broad fold of skin, which extends from the sides of the neck to the wrists, from these to the base of the feet, and is even continued between the hind legs so as to involve the tail, in the same way as in many of the true Chiroptera. It is evident that this membrane, which is entirely clothed with hair, is to be regarded, like the similar provision of the Flying Squirrels and Phalangers, merely as a sort of parachute, by means of which its possessor is enabled to perform leaps of amazing extent, although it must be confessed that in its general arrangement, leaving the structure of the hands out of the question, it presents a wonderful similarity to the wing of a Bat. In other respects the Galeopithecidæ exhibit, in a remarkable manner, characters intermediate between those of the Lemurs and the true Chiroptera. The form of the head is the same as in the former group, but the orbits are incomplete, as in the Bats. The dentition resembles that of the Lemurs, but presents some curious characters. The incisors are four in the upper, and six in the lower jaw; the former are placed quite at the sides of the jaw, so as to leave a wide vacant space in front, and the second or hindmost incisor is inserted by two roots, which give it the appearance of a false molar; and this is also the case with the following tooth, which may be regarded as the representative of the canine. The lower incisors project in front of the jaw, and the four intermediate ones exhibit a



Fig. 372.—Flying Lemur (*Galeopithecus volitans*).

singular structure, being very broad, flat, and deeply notched or cleft into teeth something like those of a comb. The Galeopithecidæ differ from the other Quadrumana in the possession of two pairs of pectoral mammæ.

These singular animals are all inhabitants of the Indian islands, where they live in the forests, and pass the day suspended by their hind legs, like the true Bats, from the branches of trees. The night is their period of activity, and they then climb about the trees with great ease, and glide from one tree to another by the aid of their broad lateral membranes. In this way it is said, they will pass over a space of more than a hundred yards. They appear to feed upon almost anything, but principally on fruits, insects, small birds and their eggs.

The best known species (*Galeopithecus volitans*, Fig. 372) is found in Java, Sumatra, and Borneo. It measures about twenty inches in length.

The second section of this order also includes one family,—that of the *Chiromydæ*,—which, as far as we at present know, has only a single representative, the *Chiromys madagascariensis*, or Aye-Aye, which presents characters of as problematical a nature as those of the preceding family. The *Chiromys*, in fact, appears to form the connecting link between the Quadrumana and the Rodents; and it has been placed by different zoologists sometimes in one and sometimes in the other of these orders.

In its form, this remarkable animal presents a close resemblance to a Squirrel; and, when first discovered, it was supposed to be a species of the old genus *Sciurus*. Its dentition also is almost identical with that of a Rodent animal, consisting of a pair of powerful incisor teeth in each jaw, separated from the molars by a wide empty space; the canines are entirely deficient. The skull, however, is distinguishable from that of a Rodent from its having the orbits encircled by a complete bony ring. The structure of the feet is also different, the anterior members have five very long, slender fingers, armed with claws; and the thumb, although not exactly in the same line with the other fingers, is scarcely opposable; but the posterior members are furnished with complete hands, of which the thumb has a flat nail, and the first finger a subulate claw like that of the true Lemurs. The body of this animal is clothed with longish smooth hairs, with an under coat of a woolly nature. The tail is long and bushy, and the ears large and naked. The mammæ are situated on the groin.

The Aye-Aye has been found only in the forests of Madagascar, where it appears to be very rare, as, when first discovered by Sonnerat, it was unknown to the natives, and the name Aye-Aye which he gave it is said to be their expression of surprise when the animal was first shown to them. It is a slow, nocturnal animal; but scarcely anything is known of its mode of life, some naturalists asserting that it lives on insects, whilst others suppose it to be frugivorous.

In the third group, which includes two families, and to which the name of *Prosimiæ* has been given, we find the thumbs of the hind feet always opposable, and the first finger furnished with a claw, even when the others bear nails. The teeth are of three kinds, and never show any resemblance to those of the Rodentia; the nose is usually slender and pointed, and the tail long and bushy. These animals appear to lead from the typical Quadrumana to the Insectivora.

The first family of this group, that of the *Tarsidæ*, consists of insectivorous animals, characterized by the acute tubercles of their molars. The incisors are very variable in number; the canines are large; the nose is more or less pointed; the eyes are usually very large and directed forwards, and the ears are large and membranous. The tail is long, sometimes bushy, and sometimes furnished with a tuft of longer hair

towards the tip. The tarsus in these animals is usually of considerable length; this is especially the case in the typical genus *Tarsius*, in which the toes of the hind feet vary most curiously in their development. Both the fore and hind feet are furnished with opposable thumbs. In the genus *Otolicnus*, the ears are exceedingly large like those of the Bats, and can be folded down in the same way. These are all nocturnal animals of small size, natives of the tropical parts of Africa, and some of the Indian Islands, where they live in the forests and climb about the trees at night in search of insects.

A second family, very closely allied to that of the preceding, is that of the *Nycticebidæ*, or Loris, which, in fact, differ from the Tarsidæ principally in the small size of the ears and the complete deficiency of the tail. They are also remarkable for the large size of the eyes, which are placed close together on the front of the head. There are only two known species of this family, natives of India and the Indian islands; they are nocturnal in their habits and very slow in their movements, whence the name of Slow Lemurs is frequently applied to them; their food is said to consist of small birds and insects, which they are able to capture at night, notwithstanding the extreme slowness of their movements.

The last family of the Prosimiæ is that of the *Lemuridæ*, or Lemurs, in which the true molars are furnished with blunt tubercles, indicating the more or less frugivorous habits of the animals. The dentition in the Lemurs is as follows—incisors, $\frac{4}{2}$ or $\frac{4}{4}$, of which the upper are perpendicular, the lower nearly horizontal; canines, $\frac{1-1}{1-1}$; præmolars $\frac{2-2}{2-2}$ or $\frac{3-3}{3-3}$, pointed; molars, $\frac{3-3}{3-3}$, tubercular. The upper canines are long, compressed, and sharp; but the lower ones project forwards at the side of the incisors, which they resemble in form. The head is rounded, but the snout is elongated, slender, and pointed, like that of a Fox, whence the name of Fox-nosed Monkeys, sometimes applied to the Lemurs. The legs are tolerably long, and all the thumbs are opposable; the nails are all flat, with the exception of that on the first finger of the hinder hand, which forms a sharp, subulate claw. The eyes are large, and placed on the front of the head; the ears are small; the body is covered with a soft fur, and the tail is usually elongated.

These animals, which are often exceedingly beautiful, are peculiar to the great island of Madagascar, where they appear to take the place of the Monkeys so abundant in all the tropical parts of Africa, but which do not occur in Madagascar. They are nocturnal animals, generally of great activity; they feed principally on fruits and insects, but also occasionally upon small birds and their eggs, which appear to be favourite articles of food with the Quadrumana in general. The female produces a single young one at a birth; this she attends with the most affectionate assiduity, carrying it about with her for a long time; the young Lemur at first clings to the breast of the mother, where it is almost concealed amongst the long hair, but when more mature secures itself by coiling round its parent's body (Fig. 10). In confinement these animals are gentle and playful; and although their long upper canines enable them to bite severely, they rarely exert this power except when greatly irritated.

The largest species is the Indri (*Indris brevicaudatus*), in which the tail is reduced to a mere rudiment; this animal measures about three feet in height when standing upon its hind legs. The ordinary species are about the size of large Cats. One of the most elegant species is the Ring-tailed Lemur (*Lemur Catta*), which is of a delicate

gray colour, with the cheeks and throat whitish, and the long bushy tail beautifully adorned with rings of black and white.

From the Lemurs we pass to the last great section of the Quadrumana, that of the *Simiæ*, or true Apes. In these animals the incisor teeth are always four in each jaw, and directed downwards and a little forwards; the canines are well developed in both jaws, and the molars very similar to those of the human species. The nails are either flattened or, with the exception of those of the thumbs, converted into claws; but the first finger of the hinder extremity never presents the solitary claw characteristic of the preceding section. The skin of the face is usually naked: the extremities are long, but the anterior pair are always longer in proportion than in man; in some species, indeed, the arms attain an excessive length. In these animals we notice a gradual approach in structure to the human organization, the lower species being still to a great extent *quadruped* in their form, whilst the higher ones present a more distinct resemblance in aspect and gesture to man. They are all active, mischievous creatures; but the smaller species exhibit a prying disposition and a drollery of manner which have always caused them to be regarded in a ludicrous light, whilst the larger species are ferocious brutes, whose great strength and formidable weapons render them most dangerous enemies.

Differences in the position of the nostrils enable us to divide the Apes into two great natural groups, which coincide remarkably with the geographical distribution of the animals. Thus in the Apes of the New World the nose is flat and broad, and the septum is very wide, so that the nostrils are placed far apart at the sides of the nose; in those of the Eastern Hemisphere, on the contrary, the septum is narrow and the nostrils are approximated. The former have been called *Platyrrhinæ*, and the latter *Catarrhinæ*.

The American Monkeys, or Platyrrhinæ, form two distinct families. In the first of these, that of the *Hapalidæ*, or Marmosets, there is the same number of teeth as in the Old World Apes, namely—incisors $\frac{4}{4}$, canines $\frac{1-1}{1-1}$, molars $\frac{5-5}{5-5}$, $= 32$; but the tubercles of the molars are acute, indicating the insectivorous habits of the animals. Notwithstanding this peculiarity in the dentition, however, they resemble the ordinary American Monkeys in their general structure. They are all small Monkeys, about the size of a Squirrel or a little larger; their heads are rounded, and their ears usually furnished with a tuft of hair. The hind feet are provided with an opposable thumb, which bears a flat nail; but all the other fingers of both pairs of extremities are armed with sharp claws, and the thumb of the anterior members is scarcely opposable. The tail is long and usually bushy, but never adapted for prehension; and the whole body is clothed with a soft woolly fur.



Fig. 373.—Marmoset (*Hapale penicillata*).

These elegant little creatures are found in great abundance in the forests of Brazil, where they run about the trees in a manner very similar to that of our Squirrel, which they a good deal resemble in appearance. They feed on insects and fruits, and also on birds and their eggs; indeed they seem to be very predaceous little creatures, although they may be easily tamed, and were formerly favourite pets with fashionable ladies. There are numerous species, twenty-five or thirty being already described; whilst from the reports of travellers there appear to be many more which are still unknown to naturalists.

The remainder of the American Monkeys belong to the great family of the *Cebidæ*, in which there are thirty-six teeth in all, the molars being six in number on each side of each jaw. The face is usually naked, but frequently surrounded by tufts or bushes of long hair, which give these Monkeys a singularly whiskered appearance. The Cebidæ have neither cheek pouches nor posterior callosities, which are usually possessed by the Old World Monkeys. Their fingers are all furnished with flat nails, but the thumbs

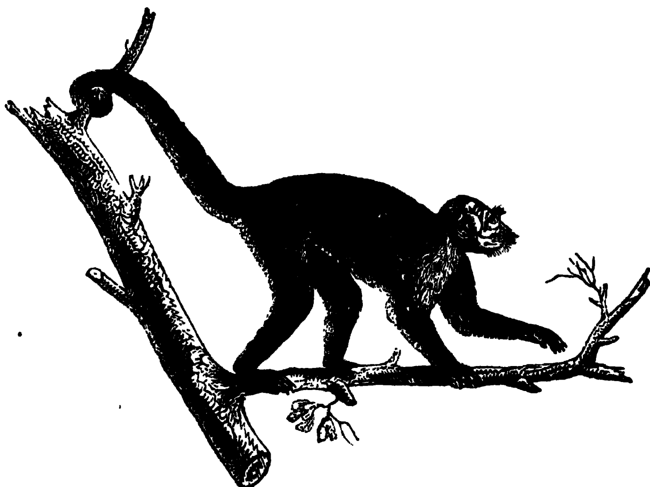


Fig. 374.—The White-throated Sajou (*Cebus hypoleucos*).

are sometimes deficient on the anterior members; and their tails are always long, and generally prehensile. Like the Hapalidæ, these Monkeys are confined to the forests of tropical America. They are light and elegant in their forms, and exhibit wonderful agility in their movements, although they are inferior in strength to the Monkeys of the Eastern Hemisphere. Their food is various, that of some species consisting almost entirely of insects, whilst others feed principally on fruits. The majority, however, appear to devour indiscriminately almost anything that comes in their way, such as fruits, seeds, insects, eggs, and birds. They are generally of moderate or small size, and appear to be of a milder and more tractable disposition than their Old World brethren.

In climbing about in the trees, the prehensile tails with which most of these animals

are furnished are of the greatest service to them; they act, in fact, in place of a third hand. This is especially the case in the Spider Monkeys (*Ateles*), in which the tail appears to possess the greatest amount of prehensile power. They often suspend the whole weight of the body upon the tail alone, and its delicacy is said to be so great that the animals can pick up small objects with it. The Spider Monkeys are destitute of thumbs on the anterior limbs. The Howling Monkeys (*Mycetes*) are also remarkable members of this family. In these animals the hyoid bone and thyroid cartilage are of immense size, and the former constitutes a bony case, which receives a large pouch communicating with the larynx. It is by the reverberation produced by this apparatus that the Howling Monkeys produce those tremendous sounds from which they have received their name, and which, when heard in the heart of the forest, are said to have a most appalling effect. According to Humboldt, they can be heard at a distance of nearly a mile. Many of the species, in which the tail is but slightly prehensile, have that organ clothed with long hairs; but in some of them its extremity is naked beneath.

The Catarrhinæ form only a single family,—that of the *Simiidæ*, or Old World Apes. In this family the dentition is the same as in Man, except the prominence of the incisors and the great size of the canines; the total number of teeth is thirty, arranged as in the Marmosets. The molars are nearly cubical, with the tubercles of the crown blunt. The tail is very variable in length, but never prehensile; in some species it is entirely deficient. Cheek pouches and callosities exist in nearly all the species. The thumbs are well developed on all the extremities, except in the genus *Colobus*, in which the anterior thumbs are wanting. All the animals of this family feed principally upon fruits and seeds, but they occasionally also feast upon small animals of different kinds and birds' eggs.

Of the Long-tailed Monkeys with cheek pouches and callosities, those forming the genus *Semnopithecus* are confined to the south of the Asiatic continent and the Indian islands. Amongst these we may notice the Hoonuman or Sacred Monkey of the Hindoos (*S. Entellus*), which is regarded with such veneration by the natives of India, from a superstitious notion that it is a "metamorphosed prince," that killing one of them is a capital crime. As might be expected, this treatment has been exceedingly favourable to the multiplication of the species, which exists in such numbers in India as to be a complete pest, from its destroying such quantities of fruit. Another species of this genus is the Proboscis Monkey (*S. larvatus*), a large Monkey which inhabits Borneo, and is remarkable for having the nostrils placed beneath a very prominent arched snout, which looks like a caricature of the Roman variety of that feature. The cheek pouches are but slightly developed in the *Semnopitheci*, but the structure of the stomach is very singularly complicated.

Nearly allied to the preceding is the genus *Colobus*, of which the species are confined to Africa. They are distinguished by the absence of thumbs on the anterior limbs. Their hair is very long, and the skins of some species inhabiting Western Africa are much used as furs. Most of the African Monkeys belong to the genus *Cercopithecus*, in which the cheek pouches are well developed, and the tail is at least as long as the body. They are small, and often rather elegant animals, which, when taken young, may be readily tamed. The species of the genus *Macacus*, and its allies are found for the most part in Asia, but some occur in the north of Africa; amongst others the Barbary Ape (*Macacus Inuus*), of which there is a colony on the Rock of Gibraltar; these are the only Wild Quadrumana in Europe. In this species

the tail is reduced to a very small size, and in an allied species, the *Cynopithecus niger*, this organ is entirely wanting.

This animal appears to lead to the Baboons (*Cynocephalus, etc.*), in which the tail is always short, and often rudimentary, the head very large, with the jaws prolonged like those of a dog, and the callosities of great size, and usually adorned with the most brilliant colours. The Baboons, which are all inhabitants of Africa, are amongst the fiercest and most disgusting of the Quadrumana. They are of large size and immense strength, and in their disposition they are generally exceedingly vicious, although instances of their being reduced to a tame condition are not wanting. The Mandrill (*Papio Mormon*) is one of the largest of the Baboons and attains nearly the height of a man. In this species, and in the Drill (*P. leucophæa*), there is a strong ridge on each cheek, which is covered with a nakid skin; in the Drill this is black, but in the Mandrill it is of a most brilliant azure blue.

The highest group of the Quadrumana is that in which the animals are destitute alike of tails and cheek pouches; these are called the *Anthropomorphous Apes*, from their making the nearest approach to the human species. The species of these large Apes are found in the forests of Africa and Asia, where they live in flocks, and some of them even make a sort of shelter amongst the branches of the trees. Their arms are always long in proportion to their hind limbs, and this is especially the case in the Orang-Outan (*Simia Satyrus*) and the Gibbons (*Hylobates*) of the East, in which the arms are so long as to reach the ground when the animal is upright. The Gibbons have callosities on the buttocks, which is not the case in the Orang. The Chimpanzees (*Troglodytes*) are the most anthropomorphous of the Apes, and in the young state the skull and brain approach more closely to the human form than in any other mammal. The difference is, however, sufficiently marked, and continues increasing with the age of the animal, by the constant production of the jaws, until the head almost resembles that of one of the Baboons, to which the adult Chimpanzees scarcely yield in fierceness.

The common Chimpanzee (*T. niger*) is a large animal, measuring as much as five feet in height; it was formerly confounded with the Orang. A second species of Chimpanzees has been recently discovered on the west coast of Africa, which has been described as the type of a second genus under the name of *Gorilla*, the denomination applied by Hanno the Carthaginian voyager, some two thousand years ago, to one or other of these specias. The Gorilla is said to measure six or seven feet in height when adult, and as its strength is in proportion to its gigantic stature, it is a most formidable animal, particularly as the male always attacks a man when he sees him.

### Order XIV. Bimana.

The last and highest order of the Mammalia includes only the human species. By Linnæus it was amalgamated with the Monkeys and Bats in his order *Primates;* subsequent writers separated it under the above denomination, and some even refused to allow the human race to enter the zoological series at all. Some modern zoologists, however, have recurred to the views of Linnæus so far as to have revived the order of Primates for the reception of Man and the Quadrumana, holding that the highest of the latter tread so closely upon the heels of humanity that it is not easy to draw the line between them. This view is also held by the advocates of the theory of the progressive development of animals, whose object, of course, must be to lessen as much as possible the distance between the most anthropomorphous Apes and the

human race; but any one who will compare an Orang or Chimpanzee with a Man will at once see that the differences in organization are so great, that it would require many steps of progressive development to pass from the one to the other. Independently of the great bulk of the brain, and the consequently increased size of the skull in the human species, the bones of the face are much smaller in proportion and less prominent, the teeth are more even, and form a continuous row in each jaw. The arms are much shorter than in the highest Apes, and the thumb is much longer in proportion to the fingers, and endowed with a greater degree of opposability and power of motion; and the hand is consequently adapted for a greater variety of purposes. But it is in the adaptation of the hind limbs solely to the purposes of terrestrial progression that we find the greatest difference between Man and the Apes. In the latter these members are shorter than the arms, and always furnished with an opposable thumb; the animals never walk upright from choice, and when they do their gait is awkward and hobbling, from their inability to apply the whole sole of the foot to the ground. In Man, on the contrary, the development of the posterior members is carried to a great perfection, the thigh especially being longer and more powerful in proportion than in any other animal; the flat sole of the foot affords a firm base, and the anterior members are thus left free for the performance of those multifarious offices to which Man is undoubtedly indebted for the whole of his physical superiority over all other created beings.

The preceding remarks are only intended to show that although physically Man must be regarded as belonging to the class Mammalia, there are sufficient differences to warrant us in keeping him quite separate from the Quadrumana. In other respects the natural history of Man is so mixed up with considerations not strictly of a zoological nature, that we shall follow the example of those who, for various reasons, have excluded our species from their treatises on zoology, more especially as one of the most important branches of the subject, the "Varieties of Man," has already been ably treated of by Dr. Latham in the first volume of this series.

W. S. DALLAS.

# INDEX

## Glossarial, Explanatory, and Referential.

### A

B

F



G

## N

U

V



W



X



Y

Z

THE completion of the above Treatises marks an epoch in this undertaking which the Conductors venture to think will justify them in an appeal to those among their fellow-citizens who are interested in the promotion of sound scientific knowledge. To CLERGYMEN, SCHOOLMASTERS, and DIRECTORS OF INSTITUTIONS for Adult Education, and for Self-instruction more especially, they would point out the existence of a Work, recommended at once by the names of the eminent men who have contributed to its pages, and by the very moderate price at which it is published.

In the CIRCLE OF THE SCIENCES it has been the aim of the Conductors to have every object treated in a philosophic spirit; not merely reproduced abridgments of larger works or dry details of Art Processes, but a series of Treatises exhibiting the fundamental principles on which each branch of Science is based. It will probably be admitted that they have taken the best means of attaining their object when the names of Professor OWEN, Dr. LATHAM, Professors YOUNG and TWISDEN, Professor TENNANT, the Rev. WALTER MITCHELL, and Professor ANSTED are given as the writers of the Treatises already completed, or on the point of completion.

Amid so great a variety of subjects as the Work embraces, there are some which must involve references to the very foundation of philosophic speculation. It is proper, therefore, to indicate the path which, in this respect, will be pursued. In treating of Physical Science, and the various phenomena by which the subject is illustrated, these Treatises will indicate the Baconian rule, that nothing in the phenomena themselves but uniform law is discoverable; but they will sedulously maintain the doctrine—without, however, going out of their path to do so—that Nature does manifest the existence of a Law Giver as well as a Law,—of a personal Omnipotence superior to Law—of a Creator who made the universe by His Fiat and maintains it by His power.

---

The subject intended to follow the present Volume will be

# PRACTICAL CHEMISTRY

CONSISTING OF

Electro-Deposition of Metals, Photography, the Chemistry of Food, and Artificial Light, which subjects will be continued until they are complete, without interruption.

---

LONDON:
HOULSTON AND STONEMAN, 65, PATERNOSTER ROW;
WM. S. ORR AND CO., AMEN CORNER.